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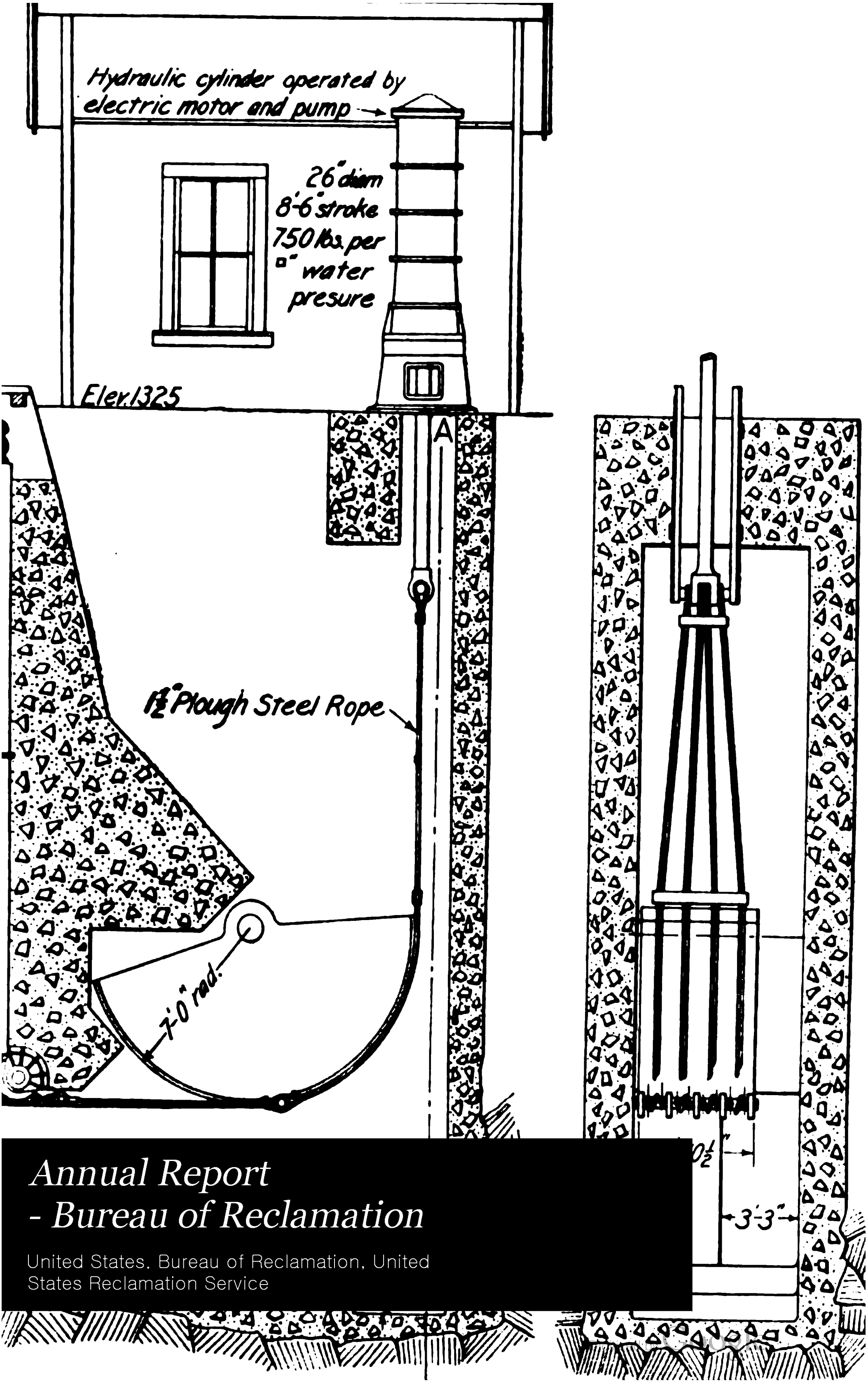

Annual Report - Bureau of Reclamation

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FIFTH ANNUAL REPORT

OF THE

RECLAMATION SERVICE

1906

F. H. NEWELL, Chief Engineer

DEPARTMENT OF THE INTERIOR

WASHINGTON
GOVERNMENT PRINTING OFFICE.
1907

CONTENTS.

Page.
General discussion 15
  The reclamation act and later acts affecting the operations thereunder 15
    Reclamation act 15
    Extension of reclamation act to Texas 17
    Town sites and leasing of surplus power 17
    Farm units, town sites, desert-land entries, etc 18
    Use of materials from public lands and forest reserves 19
    Proceeds of sales 20
    Indian allotments 20
    Changing level of lakes in California and Oregon 20
    Dams across Yellowstone River, Montana 20
    Indian lands along Colorado River 21
    Pyramid Lake Indian Reservation 21
    Crow Indian Reservation 21
    Yakima Indian Reservation 22
    Fort Shaw Military Reservation 23
  Decisions of the Secretary of the Interior 24
    Withdrawal of land 24
    Restoration of lands 24
    Entries and selections 24
    Land and property purchases 25
    Force account work 26
    Disposition of property not needed at time of acquisition 26
    Water rights 26
    Authority to drill well 26
    Residence 27
    Relinquishment 27
    Leases 27
    Defaulting contractors 28
  Water users' associations 28
  Litigation 29
    Arizona 29
    California 29
    Colorado 30
    Idaho 30
    Nebraska 31
    Nevada 31
    New Mexico 31
    Oregon 31
    Washington 32
  Purchases of rights or property 32
  Labor conditions 36
  Transportation office 37
  Finances 39
    Receipts 39
    Allotments 43
    Expenditures 45
    Liabilities and future expenditures 49
    Detailed analysis of expenditures 51
    Fiscal authorization 51
    Incurrence of expense 53
      Personal service 53
      Contracts 57
    Advertising 57
    Accounting 58

262979

General discussion—Continued.

Page.

Cost keeping 58
Unit prices 61

Arizona 85
- Salt River project 85
  - General statement 85
  - Roosevelt dam 86
  - Outlet tunnel and gates 87
  - Power canal 87
  - Diversion dam for power canal 87
  - Power plant 88
  - Sand-crushing plant 88
  - Cement mill 88
  - Telephone line 89
  - Arizona canal system 89
  - Granite Reef dam 90
  - Irrigable lands 90
  - Expenditures 91
- Proposed San Pedro project 92
- Proposed San Carlos project 92
- Proposed Little Colorado project 93

California 94
- Sacramento Valley investigations 94
  - Description of Sacramento Valley 94
  - Work accomplished 95
  - Relation of storage reservoirs to flood flow 97
  - Expenditures 98
- Proposed Owens Valley project 98
- Proposed San Joaquin project 99

California-Arizona 100
- Yuma project 100
  - General statement 100
  - Laguna dam and gates 101
  - Gila crossing 101
  - Dikes 102
  - Yuma conduit 102
  - Distribution system 102
  - Irrigable lands 102
  - Conditions in Imperial Valley 103
  - Expenditures 105

Colorado 106
- Uncompahgre Valley project 106
  - General statement 106
  - Gunnison tunnel 107
  - South canal 110
  - East canal 111
  - West canal 111
  - Distribution system 112
  - Irrigable lands 112
  - Expenditures 113
- Proposed Grand Valley project 114
- Colorado River storage 114
- Proposed White River project 115

Idaho 116
- Minidoka project 116
  - General statement 116
  - Dam and spillway 117
  - Main canals 118
  - Distribution system 118
  - Town sites 119
  - Jackson Lake reservoir 119
  - Right of way 120
  - Irrigable lands 120
  - Expenditures 121
- Payette-Boise project 121
  - General statement 121
  - Boise dam 124
  - Gates 125

Idaho—Continued. Page.
  Payette-Boise project—Continued.
    Main canal........ 126
    Upper Deer Flat embankment........ 129
    Lower Deer Flat embankment........ 130
    Cement........ 131
    Irrigable lands........ 131
    Right of way........ 133
    Litigation........ 134
    Expenditures........ 135
  Proposed Dubois project........ 136
Kansas........ 137
  Garden City project........ 137
    General statement........ 137
    Power plant........ 138
    Test wells........ 139
    Rights of way........ 139
    Irrigable lands........ 140
    Private pumping plants........ 140
    Expenditures........ 140
Montana........ 142
  Huntley project........ 142
    General statement........ 142
    Main canal........ 143
    Distributing system........ 146
    Telephone system........ 148
    Cement........ 149
    Irrigable lands........ 149
    Expenditures........ 150
  Milk River project........ 151
    General statement........ 151
    St. Mary basin........ 152
    Lower Milk River basin........ 153
    Irrigable area........ 154
    Expenditures........ 155
  Sun River project........ 155
    General statement........ 155
    Fort Shaw unit........ 157
    Willow Creek reservoir........ 158
    Adjudication of water rights........ 158
  Proposed Lake basin project........ 159
  Proposed Clarke Fork project........ 164
  Proposed Madison River project........ 167
  Proposed Crow Reservation project........ 172
    General description........ 172
    Fort Custer division........ 173
    Waco-Sanders division........ 173
    Bighorn division........ 173
    Expenditures........ 174
Nebraska-Wyoming........ 175
  North Platte project........ 175
    General statement........ 175
    Pathfinder dam and reservoir........ 176
    Interstate canal........ 178
    Distribution system........ 179
    Diversion dam........ 179
    Irrigable lands........ 180
    Right of way........ 180
    Litigation........ 180
    Expenditures........ 181
Nebraska........ 182
  South Platte underflow investigations........ 182
Nevada........ 183
  Truckee-Carson project........ 183
    General description........ 183
    Diversion works........ 186
      Dam........ 186
      Head-gates........ 188

Nevada—Continued. Page.
  Truckee-Carson project—Continued.
    Truckee canal in Truckee Canyon 189
      General character 189
      Concrete lining 189
      Tunnels 190
      Structures 191
        Upper wasteway 191
        Lower wasteway 192
        Headworks of Pyramid Branch canal 193
        Farm take-offs 194
    Truckee canal below Truckee Canyon 194
      General character 194
      Terminal chute 195
    Distributing canals 196
      Headworks 196
      South side distributing canals 196
      North side distribution canal 197
      Lateral distribution system 197
    Carson River old channel improvement 200
    Duty of water 200
    Telephone construction 201
    Work in progress 201
    Maintenance and operation 202
    Irrigable lands 206
    Expenditures 207
  Proposed Walker River project 207
New Mexico 209
  Carlsbad project 209
    General features 209
    Black River canal 210
    Avalon dam 210
    Main canal 211
    Irrigable lands 212
    Expenditures 213
  Hondo project 214
    General statement 214
    Reservoir and intake canal 215
    Outlet and distributing canals 215
    Telephone line and office building 217
    Irrigable lands 217
    Expenditures 217
  Proposed Las Vegas project 218
  Proposed Urton Lake project 218
  Proposed La Plata Valley project 219
New Mexico-Texas 220
  Rio Grande project 220
    Leasburg diversion 220
      General statement 220
      Diversion dam and canal 222
      Irrigated lands 223
      Expenditures 224
North Dakota 225
  Williston district projects 225
    General features 225
      Fuel value of lignite 225
      Cost of lignite 226
      Conditions controlling the location of stations 226
      Advantages of using electric power 227
      Floating pumping station 227
      Missouri River fluctuations 227
      Silt measurement 228
      Settling basins 228
      Duty of water 229
    Buford-Trenton project 229
    Williston project 230
    Nesson project 231
    Future extensions 233

North Dakota—Continued. Page.

- Proposed Bismarck project 233
- Proposed Little Missouri project 233

North Dakota-Montana 234
- Lower Yellowstone project 234
  - General statement 234
  - Main canal and laterals 235
  - Diversion dam 239
  - Telephone line and cement 240
  - Steel 241
  - Sluice gates 242
  - Irrigable lands 242
  - Expenditures 243

Oklahoma 244

Oregon 247
- Umatilla project 247
  - East division 247
    - General statement 247
    - Feed canal 248
    - Cold Springs dam 249
    - Cement 250
    - Steel 250
    - Irrigable lands 250
    - Right of way 251
    - Water users' association 252
  - West division 252
  - Expenditures 253
- Proposed Malheur project 253
- Proposed Central Oregon projects 254

Oregon-California 255
- Klamath project 255
  - General statement 255
  - Main canal 256
  - East Branch canal and Poe Valley laterals 261
  - Laterals under main canal 261
  - General surveys 261
  - Purchase of lands and rights of way 262
  - Water users' association 263
  - Irrigable lands 264
  - Expenditures 264

South Dakota 265
- Belle Fourche project 265
  - General statement 265
  - Diversion dam and inlet canal 266
  - Belle Fourche reservoir and dam 267
  - North and South canals 267
  - Distribution system 268
  - Bridges 268
  - Cement 268
  - Irrigable lands 269
  - Water users' association 269
  - Town sites 270
  - Expenditures 270

Utah 271
- Strawberry Valley project 271
- Proposed Bear Lake project 273
- Proposed Utah Lake project 274

Washington 275
- Okanogan project 275
  - General statement 275
  - Reservoirs 276
  - Canals and distribution system 277
  - Cement and gates 278
  - Water users' association 278
  - Purchase of lands and right of way 278
  - Irrigable lands 278
  - Expenditures 279

Washington—Continued.

Page.
- Yakima district projects 279
  - General statement 279
  - Adjustment of water rights 280
  - Storage 282
  - Hydrographic work 284
  - Roads 284
  - Tieton project 284
  - Sunnyside project 286
  - Wapato project 288
  - Proposed Kittitas project 290
  - Proposed Benton project 291
- Proposed Palouse project 292
- Proposed Priest Rapids project 292
- Use of State waters for irrigation 293

Wyoming 296
- Shoshone project 296
  - General statement 296
  - Shoshone dam 297
  - Corbett tunnel 297
  - Corbett dam 298
  - Canals 298
  - Soil survey 299
  - Cement 299
  - Lumber 300
  - Land purchases 300
  - Irrigable lands 300
  - Expenditures 301
- Proposed Lake De Smet project 301

Index 305

ILLUSTRATIONS.

Page.

PLATE I. Roosevelt, Ariz., looking down Salt River from within the reservoir site, Salt River project, Arizona........ 86
II. Construction work on the Roosevelt dam, Salt River project..... 86
III. *A*, Outlet of Pinto pressure pipe on power canal, Salt River project; *B*, Intake of Cottonwood pressure pipe on power canal, Salt River project........ 86
IV. *A*, Forms and reenforcing for Pinto reenforced concrete pressure pipe, Salt River project; *B*, Hangers for outside forms for Pinto reenforced concrete pressure pipe, Salt River project........ 86
V. Intake works and temporary brush dam at the head of the power canal, Salt River project........ 86
VI. Diversion dam in Salt River at head of power canal, Salt River project........ 88
VII. General map showing location of the Granite Reef dam and new headworks for the Arizona canal, Salt River project........ 90
VIII. Plan of the Granite Reef diversion dam and headworks for Arizona canal, Salt River project........ 90
IX. Sections of Granite Reef dam at head of Arizona canal, Salt River project........ 90
X. Proposed plan of headworks for Arizona canal at north end of Granite Reef dam, Salt River project........ 90
XI. Operating mechanism for sluice gates, Granite Reef dam, Salt River project........ 90
XII. General progress map of Yuma project, California-Arizona....... 100
XIII. United States Reclamation Service headquarters, Yuma project. 102
XIV. Laguna dam, Yuma project, from the Arizona side........ 102
XV. Laguna dam, Yuma project, from the California side........ 102
XVI. Laguna dam, Yuma project, from the Arizona side during high water........ 102
XVII. *A*, Completed section of upstream face of Laguna dam, Yuma project; *B*, Rock fill, crest and middle core walls of Laguna dam, Yuma project........ 102
XVIII. *A*, Core walls and rock fill, Laguna dam, Yuma project; *B*, Section of rock paving between core walls, Laguna dam, Yuma project........ 102
XIX. Plan of sluice gates, canal regulator, etc., on Arizona side of Laguna dam, Yuma project........ 104
XX. Details of sluice gates on Arizona side of Laguna dam, Yuma project........ 104
XXI. Details of canal regulator, Laguna dam, Yuma project........ 104
XXII. General map of the Uncompahgre Valley project, Colorado...... 106
XXIII. Lujane, Colorado, Uncompahgre Valley project........ 108
XXIV. River Portal, Colorado, Uncompahgre Valley project........ 108
XXV. Profile of Gunnison tunnel, Uncompahgre Valley project, showing progress of work........ 108
XXVI. *A*, East Portal of tunnel No. 2, south canal, Uncompahgre Valley project; *B*, Concrete-lined section on South canal, Uncompahgre Valley project........ 110
XXVII. *A*, Typical 10-foot drop on south canal, Uncompahgre Valley project; *B*, Concrete-lined section on south canal, Uncompahgre Valley project........ 110
XXVIII. Minidoka dam from the south side, Minidoka project, Idaho.... 116
XXIX. Minidoka dam, regulating works and headworks of main canal, Minidoka project, Idaho, from the north side........ 116

Page.
Plate XXX. Spillway on south side of Minidoka dam, Minidoka project...... 116
XXXI. Downstream face of controlling works in diversion channel, Minidoka dam, Minidoka project, showing completed work.... 118
XXXII. Upstream face of controlling works in diversion channel, Minidoka dam, Minidoka project, showing gates in position............. 118
XXXIII. *A*, Cut-off and core walls, north end of Minidoka dam, Minidoka project; *B*, Downstream view of controlling works in diversion channel, Minidoka dam, Minidoka project, showing the entire flow of Snake River, passing through gates and penstock openings.. 118
XXXIV. Upstream face of headworks of main canal, Minidoka project... 118
XXXV. General progress map of Payette-Boise project. Idaho............ 122
XXXVI. General plan of dam and headworks in Boise River, Payette-Boise project 124
XXXVII. Fish ladder at dam in Boise River, Payette-Boise project......... 124
XXXVIII. Boise River dam under construction, Payette-Boise project.... 124
XXXIX. Upper and lower embankments, Deer Flat reservoir, Payette-Boise project.. 130
XL. East end outlet from upper embankment, Deer Flat reservoir, Payette-Boise project..................................... 130
XLI. Discharge diagram of Boise River, showing court decree of water rights, Payette-Boise project.................................. 134
XLII. *A* and *B*. First culvert on the main canal under the Chicago, Burlington, and Quincy Railroad, Huntley project, Montana...... 144
XLIII. General map of the St. Mary basin, Montana.................... 152
XLIV. Cross sections of the St. Mary canal, St. Mary basin.............. 152
XLV. General map of proposed Clarke Fork project, Montana........... 166
XLVI. Contractor's plant at Pathfinder dam, North Platte project, Nebraska-Wyoming.. 176
XLVII. Views showing progress on Pathfinder dam, North Platte project... 176
XLVIII. Cross sections of Interstate canal, North Platte project........... 178
XLIX. Reenforced concrete flume at Spring Canyon draw, Interstate canal, North Platte project 178
L. *A* Flume across Cotttonwood Wash, Interstate canal, North Platte project; *B*, Lined section on Interstate canal at Mollies Fork, North Platte project.................................... 178
LI. General plan of diversion dam in North Platte River and headworks for Interstate canal, North Platte project............... 180
LII. Headworks for Interstate canal, North Platte project............ 180
LIII. Sections of diversion dam in North Platte River, North Platte project.. 180
LIV. General map of Truckee-Carson project, Nevada, showing distribution system 186
LV. General map of Carlsbad project, New Mexico..................... 210
LVI. Remains of Avalon dam, built by the Pecos Irrigation Company, Carlsbad project 210
LVII. General plan of Avalon dam, showing topography of site, Carlsbad project.. 210
LVIII. Plan and cross sections of Avalon dam, Carlsbad project......... 210
LIX. Concrete flume across Pecos River, Carlsbad project............ 212
LX. General map of Hondo project, New Mexico....................... 214
LXI. *A*, Spillway No. 1 on Inlet canal, Hondo project; *B*, Section of completed embankment No. 5, Hondo project............... 216
LXII. Embankment No. 5, Hondo reservoir, Hondo project........... 216
LXIII. Outlet tower of Hondo reservoir, Hondo project............... 216
LXIV. Topographic map showing location of Leasburg dam and canal, Rio Grande project, New Mexico-Texas...................... 222
LXV. Plan and details of Leasburg diversion dam, Rio Grande project.. 222
LXVI. Headworks of Leasburg canal, Rio Grande project............... 222
LXVII. View of Leasburg diversion dam site, Rio Grande project........ 224
LXVIII. *A*, Penasco Rock, the east abutment of the Leasburg diversion dam, Rio Grande project; *B*, Leasburg diversion dam site, Rio Grande project, from the east abutment....................... 224
LXIX. Diagram showing gage heights of Missouri River at Buford and Williston, N. Dak., and rainfall at Williston.................. 228

Page

Plate LXX. General map of Buford-Trenton project, North Dakota.......... 230
LXXI. Floating pumping station, Buford-Trenton project............... 230
LXXII. Pumping station No. 2, Buford-Trenton project................. 230
LXXIII. General map of Williston project, North Dakota................ 230
LXXIV. General map of the Umatilla project, east division, Oregon........ 248
LXXV. Diversion dam in Umatilla River, Umatilla project.............. 248
LXXVI. Cross sections of storage feed canal, Umatilla project............ 248
LXXVII. Plan of dam, Cold Springs reservoir, Umatilla project............ 250
LXXVIII. Longitudinal profile and cross sections of Cold Springs dam, Umatilla project.. 250
LXXIX. General progress map of Klamath project, Oregon-California..... 256
LXXX. *A*, Lake Ewauna, Oreg; *B*, Looking northwest from the lower end of Upper Klamath Lake, Klamath project.................. 256
LXXXI. *A*, Ankeny canal, Klamath project; *B*, Klamath Falls, Link River, Oregon... 256
LXXXII. Main canal, Klamath project 258
LXXXIII. *A*, Lower portal of tunnel on main canal, Klamath project; *B*, Main canal above tunnel, Klamath project......................... 258
LXXXIV. Headworks for main canal, Klamath project...................... 258
LXXXV. Details of ball-bearing gate-lifting device at headworks of main canal, Klamath project....................................... 260
LXXXVI. Cross sections of main canal and tunnel, Klamath project....... 260
LXXXVII. *A*, Inlet canal, Belle Fourche project, South Dakota; *B*, Diversion dam and headworks in Belle Fourche River, Belle Fourche project... 266
LXXXVIII. *A*, Crow Creek wasteway and sluice, inlet canal, Belle Fourche project; *B*, Regulator at headworks of inlet canal, Belle Fourche project... 266
LXXXIX. General map of Strawberry Valley project, Utah............... 272
XC. Profile and cross section of tunnel and cross sections of canal, Strawberry Valley project.................................... 272
XCI. General map of Okanogan project, Washington................. 276
XCII. Map of Conconully and Salmon Creek reservoir sites, Okanogan project... 276
XCIII. *A*, Temporary dam in Shoshone River and flume for diverting water during construction of Shoshone dam, Shoshone project; *B*, Top of right abutment of Shoshone dam, Shoshone project... 296
XCIV. *A*, Constructing temporary dam in Shoshone River, Shoshone project; *B*, Upstream face of temporary dam, Shoshone River, Shoshone project.. 296
XCV. Contractor's camp at upper end of Corbett tunnel, Shoshone project... 296
XCVI. *A*, Portal adit No. 1, Corbett tunnel, Shoshone project; *B*, Portal adit No. 3, Corbett tunnel, Shoshone project................ 296
XCVII. *A*, Concrete-lined portion of Corbett tunnel, Shoshone project; *B*, Timber-lined section, Corbett tunnel, Shoshone project... 296
XCVIII. Plan of Corbett dam and headworks at Corbett tunnel, Shoshone project... 298
XCIX. Details of Corbett dam and headworks at Corbett tunnel, Shoshone project... 298
C. Map of settling basin at end of Corbett tunnel, showing headworks of Garland canal and related structures, Shoshone project... 298
CI. Plan and section of headworks, Garland canal, Shoshone project.. 298
Fig. 1. Diagram showing proceeds from sales of public lands in Reclamation States, 1891 to 1908.................................. 42
2. Diagram showing growth of actual and estimated receipts and expenditures, 1901 to 1908.................................. 50

LETTERS OF TRANSMITTAL.

Department of the Interior,
Washington, December 6, 1906.

The **Speaker of the House of Representatives.**

Sir: The act of Congress approved June 17, 1902, entitled "An act appropriating the receipts from the sale and disposal of public lands in certain States and Territories to the construction of irrigation works for the reclamation of arid lands," provides (section 2) as follows:

> That the Secretary of the Interior is hereby authorized and directed to make examinations and surveys for, and to locate and construct, as herein provided, irrigation works for the storage, diversion, and development of waters, including artesian wells, and to report to Congress at the beginning of each regular session as to the results of such examinations and surveys, giving estimates of cost of all contemplated works, the quantity and location of the lands which can be irrigated therefrom, and all facts relative to the practicability of each irrigation project; also the cost of works in process of construction, as well as of those which have been completed.

In compliance with the requirements of the statute, I have the honor to inclose herewith copy of a letter from the Director of the Geological Survey, dated the 28th ultimo, transmitting the report contemplated by the above-mentioned section of the act of June 17, 1902.

Very respectfully,
E. A. Hitchcock,
Secretary.

Department of the Interior,
United States Geological Survey,
Washington, D. C., November 28, 1906.

Sir: I have the honor to transmit herewith a report of the work done and in progress under the reclamation act approved by the President on June 17, 1902, together with other information essential to an understanding of the subject.

This report supplements the First, Second, Third, and Fourth Annual Reports of the Reclamation Service already printed as Congressional documents. It relates in particular to the operations during the fiscal year ended June 30, 1906, but in a few instances information of a later date has been inserted, particularly in connection with operations that are nearly completed. The report describes the progress that has been made on projects authorized for building. In the four years that have elapsed since the passage of the act plans have been prepared for most of the large works that are to be built in the near future, and these works have been brought to a point where the construction is fairly well outlined. Already extensive areas in various parts of the arid West have been brought under water, and the problems now are those mainly of operation and maintenance rather than of building the irrigating systems.

The test of the law now comes in securing a refund of the investment already made in these large works. The time is approaching when water must be systematically distributed to the farmers and every precaution must be taken to secure effective operation of the reservoirs and canals in order to make possible the return of the money already spent.

Very respectfully,

CHAS. D. WALCOTT,
Director.

The SECRETARY OF THE INTERIOR.

DEPARTMENT OF THE INTERIOR,
UNITED STATES RECLAMATION SERVICE,
Washington, D. C., November 27, 1906.

SIR: In accordance with the provisions of section 2 of the reclamation act I have the honor to transmit herewith the manuscript for the Fifth Annual Report of the Reclamation Service.

This report relates mainly to the operations during the fiscal year ending June 30, 1906. The descriptive matter has in the main been compiled from the reports of the men in the field, but there are also general discussions of the various phases of the work.

In view of the constant demand for facts concerning the character and cost of the works of the Reclamation Service, it has been deemed wise to include in this report considerable data which are more or less technical in character, but which are sought by the general public and by engineers who are working on similar problems.

Very respectfully,

F. H. NEWELL,
Chief Engineer.

The DIRECTOR OF THE GEOLOGICAL SURVEY.

FIFTH ANNUAL REPORT

OF THE

RECLAMATION SERVICE.

F. H. NEWELL, *Chief Engineer.*

GENERAL DISCUSSION.

THE RECLAMATION ACT AND ACTS OF CONGRESS AFFECTING THE OPERATIONS THEREUNDER.

RECLAMATION ACT.

AN ACT Appropriating the receipts from the sale and disposal of public lands in certain States and Territories to the construction of irrigation works for the reclamation of arid lands.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That all moneys received from the sale and disposal of public lands in Arizona, California, Colorado, Idaho, Kansas, Montana, Nebraska, Nevada, New Mexico, North Dakota, Oklahoma, Oregon, South Dakota, Utah, Washington, and Wyoming, beginning with the fiscal year ending June thirtieth, nineteen hundred and one, including the surplus of fees and commissions in excess of allowances to registers and receivers, and excepting the five per centum of the proceeds of the sales of public lands in the above States set aside by law for educational and other purposes, shall be, and the same are hereby, reserved, set aside, and appropriated as a special fund in the Treasury to be known as the "reclamation fund," to be used in the examination and survey for and the construction and maintenance of irrigation works for the storage, diversion, and development of waters for the reclamation of arid and semiarid lands in the said States and Territories, and for the payment of all other expenditures provided for in this Act: *Provided*, That in case the receipts from the sale and disposal of public lands other than those realized from the sale and disposal of lands referred to in this section are insufficient to meet the requirements for the support of agricultural colleges in the several States and Territories, under the Act of August thirtieth, eighteen hundred and ninety, entitled "An act to apply a portion of the proceeds of the public lands to the more complete endowment and support of the colleges for the benefit of agriculture and the mechanic arts, established under the provisions of an Act of Congress approved July second, eighteen hundred and sixty-two," the deficiency, if any, in the sum necessary for the support of the said colleges shall be provided for from any moneys in the Treasury not otherwise appropriated.

SEC. 2. That the Secretary of the Interior is hereby authorized and directed to make examinations and surveys for, and to locate and construct, as herein provided, irrigation works for the storage, diversion, and development of waters, including artesian wells, and to report to Congress at the beginning of each regular session as to the results of such examinations and surveys, giving estimates of cost of all contemplated works, the quantity and location of the lands which can be irrigated therefrom, and all facts relative to the practicability of each irrigation project; also the cost of works in process of construction as well as of those which have been completed.

SEC. 3. That the Secretary of the Interior shall, before giving the public notice provided for in section four of this Act, withdraw from public entry the lands required for any irrigation works contemplated under the provisions of this Act, and shall restore to public entry any of the lands so withdrawn when, in his judgment, such lands are not required for the purposes of this Act; and the Secretary of the Interior is hereby authorized, at or immediately prior to the time of beginning the surveys for any contemplated irrigation works, to withdraw from entry, except under the homestead laws, any public lands believed to be susceptible of irrigation from said works: *Provided*, That all lands entered and entries made under the homestead laws within areas so withdrawn during such withdrawal shall be subject to all the provisions, limitations, charges, terms, and conditions of this Act; that said surveys shall be prosecuted diligently to completion, and upon the completion thereof, and of the necessary maps, plans, and estimates of cost, the Secretary of the Interior shall determine whether or not said project is practicable and advisable, and if determined to be impracticable or unadvisable he shall thereupon restore said lands to entry; that public lands which it is proposed to irrigate by means of any contemplated works shall be subject to entry only under the provisions of the homestead laws in tracts of not less than forty nor more than one hundred and sixty acres, and shall be subject to the limitations, charges, terms, and conditions herein provided: *Provided*, That the commutation provisions of the homestead laws shall not apply to entries made under this Act.

Sec. 4. That upon the determination by the Secretary of the Interior that any irrigation project is practicable, he may cause to be let contracts for the construction of the same, in such portions or sections as it may be practicable to construct and complete as parts of the whole project, providing the necessary funds for such portions or sections are available in the reclamation fund, and thereupon he shall give public notice of the lands irrigable under such project, and limit of area per entry, which limit shall represent the acreage which, in the opinion of the Secretary, may be reasonably required for the support of a family upon the lands in question; also of the charges which shall be made per acre upon the said entries, and upon lands in private ownership which may be irrigated by the waters of the said irrigation project, and the number of annual installments, not exceeding ten, in which such charges shall be paid and the time when such payments shall commence. The said charges shall be determined with a view of returning to the reclamation fund the estimated cost of construction of the project, and shall be apportioned equitably: *Provided*, That in all construction work eight hours shall constitute a day's work, and no Mongolian labor shall be employed thereon.

Sec. 5. That the entryman upon lands to be irrigated by such works shall, in addition to compliance with the homestead laws, reclaim at least one-half of the total irrigable area of his entry for agricultural purposes, and before receiving patent for the lands covered by his entry shall pay to the Government the charges apportioned against such tract, as provided in section four. No right to the use of water for land in private ownership shall be sold for a tract exceeding one hundred and sixty acres to any one landowner, and no such sale shall be made to any landowner unless he be an actual bona fide resident on such land, or occupant thereof residing in the neighborhood of said land, and no such right shall permanently attach until all payments therefor are made. The annual installments shall be paid to the receiver of the local land office of the district in which the land is situated, and a failure to make any two payments when due shall render the entry subject to cancellation, with the forfeiture of all rights under this Act, as well as of any moneys already paid thereon. All moneys received from the above sources shall be paid into the reclamation fund. Registers and receivers shall be allowed the usual commissions on all moneys paid for lands entered under this Act.

Sec. 6. That the Secretary of the Interior is hereby authorized and directed to use the reclamation fund for the operation and maintenance of all reservoirs and irrigation works constructed under the provisions of this Act: *Provided*, That when the payments required by this Act are made for the major portion of the lands irrigated from the waters of any of the works herein provided for, then the management and operation of such irrigation works shall pass to the owners of the lands irrigated thereby, to be maintained at their expense under such form of organization and under such rules and regulations as may be acceptable to the Secretary of the Interior: *Provided*, That the title to and the management and operation of the reservoirs and the works necessary for their protection and operation shall remain in the Government until otherwise provided by Congress.

Sec. 7. That where in carrying out the provisions of this Act it becomes necessary to acquire any rights or property, the Secretary of the Interior is hereby authorized to acquire the same for the United States by purchase or by condemnation under judicial process, and to pay from the reclamation fund the sums which may be needed for that purpose, and it shall be the duty of the Attorney-General of the United States upon every application of the Secretary of the Interior, under this Act, to cause proceedings to be commenced for condemnation within thirty days from the receipt of the application at the Department of Justice.

SEC. 8. That nothing in this Act shall be construed as affecting or intended to affect or to in any way interfere with the laws of any State or Territory relating to the control, appropriation, use, or distribution of water used in irrigation, or any vested right acquired thereunder, and the Secretary of the Interior, in carrying out the provisions of this Act, shall proceed in conformity with such laws, and nothing herein shall in any way affect any right of any State or of the Federal Government or of any landowner, appropriator, or user of water in, to, or from any interstate stream or the waters thereof: *Provided*, That the right to the use of water acquired under the provisions of this Act shall be appurtenant to the land irrigated, and beneficial use shall be the basis, the measure, and the limit of the right.

SEC. 9. That it is hereby declared to be the duty of the Secretary of the Interior in carrying out the provisions of this Act, so far as the same may be practicable and subject to the existence of feasible irrigation projects, to expend the major portion of the funds arising from the sale of public lands within each State and Territory hereinbefore named for the benefit of arid and semiarid lands within the limits of such State or Territory: *Provided*, That the Secretary may temporarily use such portion of said funds for the benefit of arid or semiarid lands in any particular State or Territory hereinbefore named as he may deem advisable, but when so used the excess shall be restored to the fund as soon as practicable, to the end that ultimately, and in any event, within each ten-year period after the passage of this Act, the expenditures for the benefit of the said States and Territories shall be equalized according to the proportions and subject to the conditions as to practicability and feasibility aforesaid.

SEC. 10. That the Secretary of the Interior is hereby authorized to perform any and all acts and to make such rules and regulations as may be necessary and proper for the purpose of carrying the provisions of this Act into full force and effect. [32 Stat. L., 388.]

Approved, June 17, 1902.

EXTENSION OF RECLAMATION ACT TO TEXAS.

AN ACT Relating to the construction of a dam and reservoir on the Rio Grande, in New Mexico, for the impounding of the flood waters of said river for purposes of irrigation.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the provisions of the reclamation Act approved June seventeenth, nineteen hundred and two, shall be extended for the purposes of this Act to the portion of the State of Texas bordering upon the Rio Grande which can be irrigated from a dam to be constructed near Engle, in the Territory of New Mexico, on the Rio Grande, to store the flood waters of that river, and if there shall be ascertained to be sufficient land in New Mexico and in Texas which can be supplied with the stored water at a cost which shall render the project feasible and return to the reclamation fund the cost of the enterprise, then the Secretary of the Interior may proceed with the work of constructing a dam on the Rio Grande as part of the general system of irrigation, should all other conditions as regards feasibility be found satisfactory. (33 Stat. L., 814.)

Approved, February 25, 1905.

AN ACT To extend the irrigation Act to the State of Texas.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the provisions of the Act entitled "An Act appropriating the receipts from the sale and disposal of public lands in certain States and Territories to the construction of irrigation works for the reclamation of arid lands," approved June seventeenth, nineteen hundred and two, be, and the same are hereby, extended so as to include and apply to the State of Texas. (34 Stat. L., 259.)

Approved, June 12, 1906.

TOWNSITES AND LEASING OF SURPLUS POWER.

AN ACT Providing for the withdrawal from public entry of lands needed for town-site purposes in connection with irrigation projects under the reclamation Act of June seventeenth, nineteen hundred and two, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the Secretary of the Interior may withdraw from public entry any lands needed for town-site purposes in connection with irrigation projects under the reclamation Act of June seventeenth, nineteen hundred and two, not exceeding one hundred and sixty acres in each case, and survey and subdivide the same into town lots, with appropriate reservations for public purposes.

Sec. 2. That the lots so surveyed shall be appraised under the direction of the Secre-of the Interior and sold under his direction at not less than their appraised value at public auction to the highest bidders, from time to time, for cash, and the lots offered for sale and not disposed of may afterwards be sold at not less than the appraised value under such regulations at the Secretary of the Interior may prescribe. Reclamation funds may be used to defray the necessary expenses of appraisement and sale, and the proceeds of such sales shall be covered into the reclamation fund.

Sec. 3. That the public reservations in such town sites shall be improved and maintained by the town authorities at the expense of the town; and upon the organization thereof as municipal corporations the said reservations shall be conveyed to such corporations by the Secretary of the Interior, subject to the condition that they shall be used forever for public purposes.

Sec. 4. That the Secretary of the Interior shall, in accordance with the provisions of the reclamation Act, provide for water rights in amount he may deem necessary for the towns established as herein provided, and may enter into contract with the proper authorities of such towns, and other towns or cities on or in the immediate vicinity of irrigation projects, which shall have a water right from the same source as that of said project for the delivery of such water supply to some convenient point, and for the payment into the reclamation fund of charges for the same to be paid by such towns or cities, which charges shall not be less nor upon terms more favorable than those fixed by the Secretary of the Interior for the irrigation project from which the water is taken.

Sec. 5. That whenever a development of power is necessary for the irrigation of lands under any project undertaken under the said reclamation Act, or an opportunity is afforded for the development of power under any such project, the Secretary of the Interior is authorized to lease for a period not exceeding ten years, giving preference to municipal purposes, any surplus power or power privilege, and the moneys derived from such leases shall be covered into the reclamation fund and be placed to the credit of the project from which such power is derived: *Provided*, That no lease shall be made of such surplus power or power privilege as will impair the efficiency of the irrigation project. (34 Stat. L., 116.)

Approved, April 16, 1906.

FARM UNITS, TOWNSITES, DESERT LAND ENTRIES, ETC.

AN ACT Providing for the subdivision of lands entered under the reclamation Act, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That whenever, in the opinion of the Secretary of the Interior, by reason of market conditions and the special fitness of the soil and climate for the growth of fruit and garden produce, a lesser area than forty acres may be sufficient for the support of a family on lands to be irrigated under the provisions of the Act of June seventeenth, nineteen hundred and two, known as the reclamation Act, he may fix a lesser area than forty acres as the minimum entry and may establish farm units of not less than ten nor more than one hundred and sixty acres. That wherever it may be necessary, for the purpose of accurate description, to further subdivide lands to be irrigated under the provisions of said reclamation Act, the Secretary of the Interior may cause subdivision surveys to be made by the officers of the reclamation service, which subdivisions shall be rectangular in form, except in cases where irregular subdivisions may be necessary in order to provide for practicable and economical irrigation. Such subdivision surveys shall be noted upon the tract books in the General Land Office, and they shall be paid for from the reclamation fund: *Provided*, That an entryman may elect to enter under said reclamation Act a lesser area than the minimum limit in any State or Territory.

Sec. 2. That wherever the Secretary of the Interior, in carrying out the provisions of the reclamation Act, shall acquire by relinquishment lands covered by a bona fide unperfected entry under the land laws of the United States, the entryman upon such tract may make another and additional entry, as though the entry thus relinquished had not been made.

Sec. 3. That any town site heretofore set apart or established by proclamation of the President, under the provisions of sections twenty-three hundred and eighty and twenty-three hundred and eighty-one of the Revised Statutes of the United States, within or in the vicinity of any reclamation project, may be appraised and disposed of in accordance with the provisions of the Act of Congress approved April sixteenth, nineteen hundred and six, entitled "An Act providing for the withdrawal from public entry of lands needed for town-site purposes in connection with irrigation projects under the reclamation Act of June seventeenth, nineteen hundred and two, and for other purposes;" and all necessary expenses incurred in the appraisal and sale of lands embraced within any such town site shall be paid from the reclamation fund, and the proceeds of the sales of such lands shall be covered into the reclamation fund.

SEC. 4. That in the town sites of Heyburn and Rupert, in Idaho, created and surveyed by the Government, on which town sites settlers have been allowed to establish themselves, and had actually established themselves prior to March fifth, nineteen hundred and six, in permanent buildings not easily moved, the said settlers shall be given the right to purchase the lots so built upon at an appraised valuation for cash, such appraisement to be made under rules to be prescribed by the Secretary of the Interior. Providing that the limitation on the size of townsites contained in the Act of April sixteenth, nineteen hundred and six, entitled "An Act providing for the withdrawal from public entry of lands needed for townsite purposes in connection with irrigation projects under the reclamation Act of June seventeenth, nineteen hundred and two, and for other purposes," shall not apply to the townsites named in this section; and whenever, in the opinion of the Secretary of the Interior, it shall be advisable for the public interest, he may withdraw and dispose of townsites in excess of one hundred and sixty acres under the provisions of the aforesaid Act, approved April sixteenth, nineteen hundred and six, and reclamation funds shall be available for the payment of all expenses incurred in executing the provisions of this Act, and the aforesaid Act of April sixteenth, nineteen hundred and six, and the proceeds of all sales of townsites shall be covered into the reclamation fund.

SEC. 5. That where any bona fide desert-land entry has been or may be embraced within the exterior limits of any land withdrawal or irrigation project under the Act entitled "An Act appropriating the receipts from the sale and disposal of public lands in certain States and Territories to the construction of irrigation works for the reclamation of arid lands," approved June seventeenth, nineteen hundred and two, and the desert-land entryman has been or may be directly or indirectly hindered, delayed, or prevented from making improvements or from reclaiming the land embraced in any such entry by reason of such land withdrawal or irrigation project, the time during which the desert-land entryman has been or may be so hindered, delayed, or prevented from complying with the desert land law shall not be computed in determining the time within which such entryman has been or may be required to make improvements or reclaim the land embraced within any such desert-land entry: *Provided*, That if after investigation the irrigation project has been or may be abandoned by the Government, time for compliance with the desert-land law by any such entryman shall begin to run from the date of notice of such abandonment of the project and the restoration to the public domain of the lands withdrawn in connection therewith, and credit shall be allowed for all expenditures and improvements heretofore made on any such desert-land entry of which proof has been filed; but if the reclamation project is carried to completion so as to make available a water supply for the land embraced in any such desert-land entry, the entryman shall thereupon comply with all the provisions of the aforesaid Act of June seventeenth, nineteen hundred and two, and shall relinquish all land embraced within his desert-land entry in excess of one hundred and sixty acres, and as to such one hundred and sixty acres retained, he shall be entitled to make final proof and obtain patent upon compliance with the terms of payment prescribed in said Act of June seventeenth, nineteen hundred and two, and not otherwise. But nothing herein contained shall be held to require a desert-land entryman who owns a water right and reclaims the land embraced in his entry to accept the conditions of said reclamation Act. (34 Stat. L.,519.)

Approved, June 27, 1906.

USE OF MATERIALS FROM THE PUBLIC LANDS AND FOREST RESERVES.

AN ACT Authorizing the use of earth, stone, and timber on the public lands and forest reserves of the United States in the construction of works under the national irrigation law.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That in carrying out the provisions of the national irrigation law, approved June seventeenth, nineteen hundred and two, and in constructing works thereunder, the Secretary of the Interior is hereby authorized to use and to permit the use by those engaged in the construction of works under said law, under rules and regulations to be prescribed by him, such earth, stone, and timber from the public lands of the United States as may be required in the construction of such works, and the Secretary of Agriculture is hereby authorized to permit the use of earth, stone, and timber from the forest reserves of the United States for the same purpose, under rules and regulations to be prescribed by him. (33 Stat. L., 706.)

Approved, February 8, 1905.

PROCEEDS OF SALES.

AN ACT To provide for the covering into the reclamation fund certain proceeds of sales of property purchased by the reclamation fund.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That there shall be covered into the reclamation fund established under the Act of June seventeenth, nineteen hundred and two, known as the reclamation Act, the proceeds of the sales of material utilized for temporary work and structures in connection with the operations under the said Act, as well as of the sales of all other condemned property which had been purchased under the provisions thereof, and also any moneys refunded in connection with the operations under said reclamation Act. (33 Stat. L., 1032.)

Approved, March 3, 1905.

INDIAN ALLOTMENTS.

The act of Congress approved June 21, 1906, entitled "An act making appropriations for the current and contingent expenses of the Indian Department, for fulfilling treaty stipulations with various Indian tribes, and for other purposes, for the fiscal year ending June thirtieth, nineteen hundred and seven," contains the following proviso, viz:

That any Indian allotted lands under any law or treaty without the power of alienation, and within a reclamation project approved by the Secretary of the Interior, may sell and convey any part thereof, under rules and regulations prescribed by the Secretary of the Interior, but such conveyance shall be subject to his approval, and when so approved shall convey full title to the purchaser the same as if final patent without restrictions had been issued to the allottee: *Provided,* That the consideration shall be placed in the Treasury of the United States and used by the Commissioner of Indian Affairs to pay the construction charges that may be assessed against the unsold part of the allotment, and to pay the maintenance charges thereon during the trust period, and any surplus shall be a benefit running with the water right to be paid to the holder thereof. (34 Stat. L., 327.)

CHANGING LEVELS OF LAKES IN CALIFORNIA AND OREGON.

AN ACT Authorizing the changing of the levels of certain lakes and the disposal of certain lands under the terms of the national reclamation act.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the Secretary of the Interior is hereby authorized in carrying out any irrigation project that may be undertaken by him under the terms and conditions of the national reclamation Act and which may involve the changing of the levels of Lower or Little Klamath Lake, Tule or Rhett Lake, and Goose Lake, or any river or other body of water connected therewith, in the States of Oregon and California, to raise or lower the level of said lakes as may be necessary and to dispose of any lands which may come into the possession of the United States as a result thereof by cession of any State or otherwise under the terms and conditions of the national reclamation act. (33 Stat. L., 714.)

Approved, February 9, 1905.

DAMS ACROSS YELLOWSTONE RIVER, MONTANA.

AN ACT To authorize the Secretary of the Interior to construct dams across the Yellowstone River in Montana in connection with irrigation works.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That where, in carrying out projects under the provisions of the national reclamation Act, it shall be necessary to construct dams in or across the Yellowstone River in the State of Montana, the Secretary of the Interior is hereby authorized to construct and use and operate the same in the manner and for the purposes contemplated by said reclamation Act. (33 Stat. L., 1045.)

Approved, March 3, 1905.

INDIAN LANDS ALONG COLORADO RIVER.

Section 25 of the act approved April 21, 1904 (33 Stat. L., 224), entitled "An act making appropriations for current and contingent expenses of the Indian Department, and for fulfilling treaty stipulations with various Indian tribes, for the fiscal year ended June 30, 1905, and for other purposes," provides as follows:

That in carrying out any irrigation enterprise which may be undertaken under the provisions of the reclamation act of June seventeenth, nineteen hundred and two, and which may make possible and provide for, in connection with the reclamation of other lands, the reclamation of all or any portion of the irrigable lands on the Yuma and Colorado River Indian reservations in California and Arizona, the Secretary of the Interior is hereby authorized to divert the waters of the Colorado River and to reclaim, utilize, and dispose of any lands in said reservations which may be irrigable by such works in like manner as though the same were a part of the public domain: *Provided*, That there shall be reserved for and allotted to each of the Indians belonging on the said reservations five acres of the irrigable lands. The remainder of the lands irrigable in said reservations shall be disposed of to settlers under the provisions of the reclamation act: *Provided further*, That there shall be added to the charges required to be paid under said act by settlers upon the unallotted Indian lands such sum per acre as, in the opinion of the Secretary of the Interior, shall fairly represent the value of the unallotted lands in said reservations before reclamation; said sum to be paid in annual installments in the same manner as the charges under the reclamation act. Such additional sum per acre, when paid, shall be used to pay into the reclamation fund the charges for the reclamation of the said allotted lands, and the remainder thereof shall be placed to the credit of said Indians and shall be expended from time to time, under the direction of the Secretary of the Interior, for their benefit. (34 Stat. L., 224.)

PYRAMID LAKE INDIAN RESERVATION.

Section 26 of the act mentioned in the last paragraph provides as follows:

That in carrying out any irrigation enterprise which may be undertaken under the provisions of the reclamation Act of June seventeenth, nineteen hundred and two, and which may make possible and provide for, in connection with the reclamation of other lands, the reclamation of all or any portion of the irrigable lands on the Pyramid Lake Indian Reservation, Nevada, the Secretary of the Interior is hereby authorized to reclaim, utilize, and dispose of any lands in said reservation which may be irrigable by such works in like manner as though the same were a part of the public domain: *Provided*, That there shall be reserved for and allotted to each of the Indians belonging on the said reservation five acres of the irrigable lands. The remainder of the lands irrigable in said reservation shall be disposed of to settlers under the provisions of the reclamation Act: *Provided further*, That there shall be added to the charges required to be paid under said Act by settlers upon the unallotted Indian lands such sum per acre as in the opinion of the Secretary of the Interior shall fairly represent the value of the unallotted lands in said reservation before reclamation, said sum to be paid in annual installments in the same manner as the charges under the reclamation Act. Such additional sum per acre, when paid, shall be used to pay into the reclamation fund the charges for the reclamation of the said allotted lands, and the remainder thereof shall be placed to the credit of said Indians and shall be expended from time to time, under the direction of the Secretary of the Interior, for their benefit. (34 Stat. L., 225.)

CROW INDIAN RESERVATION.

In Article II of the act approved April 27, 1904, entitled "An act to ratify and amend an agreement with the Indians of the Crow Reservation in Montana, and making appropriation to carry the same into effect," it is provided that in consideration of the land ceded, the United States agrees to dispose of the same under the provisions of the reclamation act, the homestead, town site, and mineral land laws, except sections 16 and 36, or an equivalent of two sections in each township, at not less than $4 per acre. And section 5 of the said article provides—

That before any of the lands by this agreement ceded are opened to settlement or entry the Commissioner of Indian Affairs shall cause the allotments to be made and the schedule to be prepared, as provided for in section four of this Act, and a duplicate of said schedule shall be filed with the Commissioner of the General Land Office. Upon the completion of such allotments and the filing of such schedule and after the sale or removal of such improvements the residue of such ceded lands, except sections sixteen and thirty-six, or lands in lieu thereof, which shall be reserved for common school purposes, and are hereby granted to the State of Montana for such purpose, shall be subject to withdrawal and disposition under the reclamation Act of June seventeenth, nineteen hundred and two, so far as feasible irrigation projects may be found therein. The charges provided for by said reclamation Act shall be in addition to the charge of four dollars per acre for the land, and shall be paid in annual installments as required under the reclamation Act; and the amounts to be paid for the land shall be credited to the funds herein established for the benefit of the Crow Indians. If any lands in section sixteen and thirty-six are included in an irrigation project under the reclamation Act, the State of Montana may select in lieu thereof, as herein provided, other lands not included in any such project, in accordance with the provisions of existing law concerning school lands selections. In any construction work upon the ceded lands performed directly by the United States under the reclamation Act, preference shall be given to the employment of Crow Indians, or whites intermarried with them, so far as may be practicable: *Provided, however*, That if the lands withdrawn under the reclamation Act are not disposed of within five years after the passage of this Act, then all of said lands so withdrawn shall be disposed of as other lands provided for in this Act. (34 Stat. L., 360.)

YAKIMA INDIAN RESERVATION.

CHAP. 518.—An act authorizing the disposition of surplus and allotted lands in the Yakima Indian Reservation, in the State of Washington, which can be irrigated under the Act of Congress approved June seventeenth, nineteen hundred and two, known as the reclamation Act, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That if within the limits of the Yakima Indian Reservation, in the State of Washington, as described in the Act approved December twenty-first, nineteen hundred and four, entitled "An Act to authorize the sale and disposition of surplus or unallotted lands of the Yakima Indian Reservation, in the State of Washington," there shall be found surplus or unallotted lands under irrigation projects deemed practicable and undertaken under the provisions of the Act of Congress approved June seventeenth, nineteen hundred and two, known as the reclamation Act, the Secretary of the Interior is hereby authorized to exclude from the provisions of said Act of December twenty-first, nineteen hundred and four, such surplus or unallotted lands which can be irrigated under such project and to dispose of the same in the manner hereinafter provided, and he is further authorized to make withdrawals of such lands for the purposes provided in said reclamation Act.

SEC. 2. That the irrigable surplus and unallotted lands in any such project shall be subject to homestead entry under all the provisions of the reclamation Act at such time as may be fixed by the Secretary of the Interior and at a price determined by appraisal as provided in said Act of December twenty-first, nineteen hundred and four. Payments for the land shall be made in annual installments, the number and time of beginning being fixed by the Secretary of the Interior, and shall be deposited in the Treasury of the United States and credited to the Yakima Indian fund, and disposed of as provided by section four of the said Act of December twenty-first, nineteen hundred and four. Such payments shall be in addition to the charges for construction and maintenance of the irrigation system made payable into the reclamation fund by the provisions of the reclamation Act. In case of failure to make any payment for such lands when due the Secretary of the Interior shall have power to cancel the entry and the corresponding water right and declare forfeited to the said Yakima Indian fund and the reclamation fund, respectively, the amounts paid on such entry and water right. The lands embraced within such canceled entry shall be subject to further entry under the reclamation Act at the appraised value until otherwise directed by the President, who may by proclamation, as provided by said Act of December twenty-first, nineteen hundred and four, from time to time fix such price as he may deem most advantageous upon all lands within such projects not disposed of.

SEC. 3. That if any lands heretofore allotted or patented to Indians on said Yakima Indian Reservation shall be found irrigable under any project the Secretary of the

Interior is hereby authorized, upon the request or with the consent of such allottee or patentee, to dispose of all land in excess of twenty acres in each case, in tracts of an area approved by him and subject to all the provisions of the reclamation Act to any person qualified to acquire water rights under the provisions of the reclamation Act at a price satisfactory to the allottee or patentee and approved by the Secretary of the Interior, or at public sale to the highest bidder. The payments shall be made in annual installments, the number and terms being approved by the Secretary of the Interior. Such payments shall be in addition to the charges for construction and maintenance of the irrigation system made payable into the reclamation fund by the provisions of the reclamation Act. In case of failure to make any payment for such lands when due or the charges under the reclamation Act the Secretary of the Interior shall have power to cancel the entry and the corresponding water right and again dispose of the land in the manner hereinbefore provided.

Sec. 4. That from the payments received from the sale of such individual Indian lands there shall be covered into the reclamation fund the amounts fixed by the Secretary of the Interior as the annual charges on account of the land retained by such Indian for the construction and maintenance of the irrigation system as required under the reclamation Act. The balance, if any, shall be deposited in the Treasury of the United States to the credit of the individual Indians, and may be paid to any of them if, in the opinion of the Secretary of the Interior, such payments will tend to improve the condition and advance the progress of said Indians, but not otherwise.

Sec. 5. That the Secretary of the Interior is hereby authorized to cover into the reclamation fund from the money of any such Indian, either from his individual credit or from the general Yakima Indian fund, for the payment of charges for construction and maintenance for the water rights appurtenant to the land retained by him or for the annual maintenance charges payable on account of such water rights after the construction charge thereon has been paid in full. After unconditional title in fee has passed from the United States for any lands retained by such Indians, the water for irrigating such lands shall be furnished under the same conditions in all respects as for other lands under the project: *Provided*, That any Indian taking advantage of this Act shall have a perpetual water right so long as the maintenance charges are paid, whether he uses the water or not, and the Secretary of the Interior is hereby authorized to use the funds of the tribe to pay such maintenance charges, which in his discretion it is necessary to preserve said water right: *Provided further*, That he may, in his discretion, use said funds to pay for water rights and the maintenance charges on twenty acres of any Indian allotment if the sum obtained from the sale of the allottee's land is in excess of twenty acres and his interest in the tribal funds be insufficient for those purposes.

Sec. 6. That the Secretary of the Interior shall be authorized upon compliance with the provisions of this Act and of the reclamation Act, by any party having purchased such allotted or patented lands as herein provided, to issue patent passing unconditional title in fee by the United States as trustee for the allottee or patentee, and shall cancel any allotment as to the lands disposed of under this Act.

Sec. 7. That the irrigation works heretofore constructed for the Yakima Indian Reservation may be at a cost to be determined by the Secretary of the Interior included in any project developed under the provisions of the reclamation Act and of this Act, and become a part of said project for all purposes of the reclamation Act, and the cost of same shall be included in the cost of such project and be paid into the Yakima Indian fund out of the proceeds arising from the sale of water rights, from time to time, as payments on account thereof are received. The provisions of this Act shall be construed as superseding or amending any provisions of the said Act of December twenty-first, nineteen hundred and four, so far as any conflict may appear.

Sec. 8. That the Secretary of the Interior is hereby authorized to perform any and all acts and to make such rules and regulations as may be necessary and proper for the purpose of carrying the provisions of this Act into full force and effect. (34 Stat., 53.)

Approved, March 6, 1906.

FORT SHAW MILITARY RESERVATION.

AN ACT To provide for the disposition under the public land laws of the lands in the abandoned Fort Shaw Military Reservation, Montana.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the Secretary of the Interior is hereby authorized to dispose of the lands in the abandoned Fort Shaw Military Reservation, in Montana, under the provisions of the public land laws, and the public land surveys shall be extended over the lands therein: *Provided*, That he may reserve for Indian school purposes the following-described lands in township twenty north, range two west, Montana principal meridian, as determined by the extension of the public surveys: That portion of section two lying south of Sun River, all of sections eleven, fourteen, and twenty-three, and that portion of section twenty-six lying within the present reservation boundary: *Provided further*, That before opening the reservation to entry, the Secretary of the Interior may withdraw any other lands therein needed in connection with an irrigation project under the provisions of the Act of June seventeenth, nineteen hundred and two, known as the reclamation Act, for use or disposition thereunder. (34 Stat. L., 228.)

Approved, June 9, 1906.

DECISIONS OF THE SECRETARY OF THE INTERIOR.

The following is a brief statement of decisions of general interest relating to the reclamation act which have been made by the Secretary of the Interior during the past year; a few decisions by the Comptroller of the Treasury are included:

WITHDRAWAL OF LAND.

January 25, 1906.—The instructions of October 12, 1905 (34 L. D., 158), did not contemplate that claims to lands determined to be needed for construction of irrigation works in connection with a project that has been found practicable should thereafter be allowed to be perfected, but, on the other hand, it was the evident purpose to maintain the status existing at the time the determination was made and to adjust the rights of all claimants upon the basis of that status (34 L. D., 421).

RESTORATION OF LANDS.

February 20, 1906.—The revocation of a withdrawal of its own force subjects the lands to entry and disposal under the general land laws free from all conditions, except such as are imposed by those laws, and removes the conditions prescribed by the reclamation act that had attached to entries made during the existence of the withdrawal (34 L. D., 445).

ENTRIES AND SELECTIONS.

July 14, 1905.—While desert-land entrymen and their assignees are not invested with the legal title, they have such an equitable title and interest in the land as to constitute them proprietors within the spirit and purpose of the reclamation act, and the right to use of water may be granted them, if they bring themselves within the provisions of the act that "no right to the use of water for land in private ownership shall be sold for a tract exceeding 160 acres to any one landowner, and no such sale shall be made to any landowner unless he be an actual bona fide resident on such land or occupant thereof, or residing in the neighborhood of said lands." (34 L. D., 29.) See act June 27, 1906 (34 Stat. L., 519), pp. 18–19.

December 19, 1905.—An application to make soldier's additional entry under section 2306, Revised Statutes, although filed prior to the passage of the reclamation act and pending at the date of an order withdrawing the lands covered thereby under the provisions of said act is not effective to except the lands from such withdrawal. (34 L. D., 311.)

April 13, 1906.—An application to enter under the provisions of section 2306, Revised Statutes, even though approved by the Commissioner of the General Land Office will not, prior to the allowance of entry thereof, prevent a withdrawal of the land covered thereby under the provisions of the reclamation act. (34 L. D., 560.)

March 29, 1906.—A homestead entryman who has not acquired title to his land may not convey or agree to convey to a water users' association one or more legal subdivisions of his entry to be held in trust and sold for his benefit. (34 L. D., 532.)

June 6, 1906.—Lands withdrawn under the provisions of the reclamation act from all disposition, except under the homestead laws, are not subject to soldier's additional entry under section 2306, Revised Statutes. (34 L. D., 653.)

June 6, 1906.—An entry is a contract between the Government and the entryman, and until all the requisites of an entry have been made no contract exists, and the applicant can acquire no vested rights to the land which will prevent a withdrawal thereof by the Government. (34 L. D., 653.)

June 23, 1906.—A homestead entry upon which final proof has been made showing compliance with the law up to the date thereof, but where final certificate has not issued, has the same status as an entry upon which final certificate has issued, so far as it may be affected by any withdrawal under the reclamation act.

LANDS AND PROPERTY PURCHASES.

January 6, 1906.—The reclamation act affords authority for the purchase by the United States of an incomplete irrigation system to be used in connection with and to become part of a larger system contemplated by the Government. The provisions of section 5 of the reclamation act restricting the sale of a right to the use of water for land in private ownership to not more than 160 acres will not prevent the recognition of a vested water right for a larger area and protection of the same by allowing the continued flowage of the water covered by the right through the works constructed by the Government. (34 L. D., 351.)

March 10, 1906.—No such rights are acquired by settlement upon lands embraced in the entry of another as will attach upon cancellation of such entry, where at that time the lands are withdrawn for use in connection with an irrigation project under the reclamation act, nor is there authority in the act for purchase by the Government of the settler's claim or of the improvements placed upon the land by him. (34 L. D., 478.)

April 12, 1906.—Settlers upon public lands appropriated by the Government for use in the construction and operation of irrigation works, who have made a bona fide settlement and have continued to comply with the law as to residence upon and cultivation and improvement of the land settled upon, are entitled to be compensated for their improvements, although they have not placed their claim of record because of the unsurveyed condition of the land. But the bona fide character of the settlement and the acts of the settler should be clearly established before allowing compensation, when the settler has not indicated his purpose and intent by placing his claim of record, whether from the unsurveyed condition of the land or from other cause.

May 19, 1906.—There is no law which prevents the United States from purchasing property encumbered by liens. (10 Op. Atty. Gen., 353). It is within the power of the Secretary of the Interior to make a purchase under such conditions and to exact an indemnifying bond to protect against defects of title and in order to secure immediate possession of the property. (12 Compt., 691.)

FORCE ACCOUNT WORK.

April 16, 1906.—Under the authority conferred by the reclamation act, the Secretary of the Interior may, in his discretion, enter into contracts for the construction of irrigation works or construct such works by labor employed and operated under the superintendance and direction of Government officials. (34 L. D., 567.)

DISPOSITION OF PROPERTY NOT NEEDED AT TIME OF ACQUISITION.

April 11, 1906.—In the absence of any express prohibition as to the particular property, the head of the Executive Department in whose care and custody public property is placed to be used for a particular purpose may, until the property is needed for the purpose indicated, exercise his judgment and discretion as to its proper care and disposition, and any use of it not incompatible with the purposes intended is not a diversion to other uses and neither a violation of law nor an abuse of the supervisory authority and discretion reposed in him. (34 L. D., 549.)

WATER RIGHTS.

August 16, 1905.—There is nothing in the reclamation act to prohibit a graded scale of the annual payments required of users of water from reclamation projects constructed under the said act, and in all cases where it is deemed advisable this plan of payment may be adopted upon approval by the Secretary of the Interior. (34 L. D., 78.)

February 19, 1906.—The applicant for a water right on land in private ownership must state accurately upon the proper form the nature of his interest in the land. If this interest is such that it can ripen into a perfect title, at or before the time when the last annual installment of the water right is due, the application should be received. (34 L. D., 544.)

June 25, 1906.—A person who has made or may make homestead entry upon lands withdrawn for disposal under the reclamation act may obtain water for such tract and may also obtain water for one or more tracts of which he is the proprietor, not exceeding the limit of area fixed by the statute authorizing the use of water for land in private ownership or as fixed by the Secretary of the Interior. If the entry was made prior to the withdrawal under the reclamation act, the entryman may be entitled to the right to the use of water for the irrigable area for the land entered and also for such area of lands held by him in private ownership, which added to the irrigable area of his entry will not exceed 160 acres.

AUTHORITY TO DRILL WELLS.

March 30, 1906.—The drilling of wells in the vicinity of an irrigation project for the purpose of determining whether underground water exists that may be available in connection with the project comes within the power conferred by the second section of the reclamation act, "to make examinations and surveys * * * for the development of waters." (34 L. D., 533.)

RESIDENCE.

April 7, 1906.—Twenty miles in a direct line is the maximum limit of distance for which residence will be construed as being in the neighborhood of the land for which a water right application is made.

RELINQUISHMENT.

July 16, 1906.—A relinquishment does not convey nor secure to the purchaser thereof any interest in the land, but it inures solely to the benefit of the United States. In the relinquishment of an entry of land withdrawn for disposal under the reclamation act, the land takes the same status it had at the time the relinquished entry was made, that is, withdrawn "from entry except under the homestead laws." The annual charge to be paid under the reclamation act is not a rental obligation. Every application to enter lands withdrawn for disposal under the reclamation act is an application for the water right appurtenant thereto which attaches by virtue of the statute, and the entryman is bound to pay the annual installments when due and to irrigate and reclaim one-half of the total area of his entry for agricultural purposes. The cancellation of an entry, whether by relinquishment or otherwise, carries with it a forfeiture of the water right appurtenant to such land. When the land is reentered, the water right that attaches to the land by force of the statute inures to the second entryman, who obligates himself to pay the "charges apportioned against such tract."

The cost of construction is a charge upon the land irrigated from waters of the project until the Government has been reimbursed. If any installment is not paid by an entryman, it still remains a charge upon the land entered and must be paid by a succeeding entryman before patent will be issued.

While the Secretary of the Interior may extend the annual payments through a period not exceeding ten years from the date of every entry, an installment due by a defaulting entryman is an obligation resting upon the land to which the first or subsequent entry is subject and which the Government can always enforce by withholding patent until it is paid and by canceling entry if it is not paid. (35 L. D., 29.)

LEASES.

March 10, 1906.—The Secretary of the Interior has authority to make a temporary lease of any of the lands acquired or reserved for any irrigation project, provided the use of the land under the proposed lease will not interfere with the use and control of the lands when they are needed for the purposes contemplated by the purchase or reservation of such lands. (34 L. D., 480.)

April 11, 1906.—There is no authority for leasing lands formerly within the Uinta Indian Reservation and withdrawn generally for reservoir purposes under the act of March 3, 1905, where such lands have not been appropriated for any particular purpose so as to take them out of the category of public lands. (34 L. D., 549.)

DEFAULTING CONTRACTORS.

April 20, 1906.—In the case of the suspension of the contract the Government has the right, as provided therein, to "take possession" of all materials belonging to the contractor delivered on the ground. In other words, under such circumstances, the contract provides that the Government shall act in the place and stead of the contractor, using his plant, materials, and appliances as far as possible for the completion of the work. There is no provision in the contract requiring the Government to purchase or pay for the materials thus taken. There is no purchase. They are used by the Government on the contractor's account and there exists no relationship or obligation as between the Government and the unpaid material men who furnished them. The title to such materials will legally be presumed to have passed to the contractor, as in the case of any other personality in ordinary cases, upon delivery. Of the materials, etc., thus taken possession of by the United States, due and accurate account should be kept, in order that in final settlement of the contractor's account his proper credits may be definitely ascertained. So, too, should accurate account be kept of the cost of the work, including the purchase of other materials, that the excess cost of the work, if any, above the contract price may be determined and due payment thereof demanded of the sureties. The principle stated above applies equally to materials which have been built into the work, but which were not paid for by the contractor.[a]

September 14, 1906.—The relation existing between principal and surety is not such as to justify the taking by the United States of the property of the surety under that provision of the contract authorizing the United States to suspend the contract in case of default and take possession of all machinery, tools, etc., even though the property is in the possession of the contractor, and is being used in the construction of the works as his own. Unless there is satisfactory proof that any property in the possession of a contractor and used by him in the construction of the works is the property of another, possession should be taken of all the property, and if the ownership be claimed by anyone else he should be required to prove title to his property before releasing it.

WATER USERS' ASSOCIATIONS.

The following water users' associations have been organized for cooperation with the United States under the provisions of the act of Congress approved June 17, 1902. (32 Stat. L., 388.)

Belle Fourche Valley, Belle Fourche, S. Dak.
Buford-Trenton, Buford, N. Dak.
Elephant Butte, Las Cruces, N. Mex.
El Paso Valley, El Paso, Tex.
Finney County, Garden City, Kans.
Klamath, Klamath Falls, Oreg.
Lower Milk River Valley, Malta, Mont.
Lower Yellowstone, Sydney, Mont.
North Platte Valley, Scotts Bluff, Nebr.
Okanogan, Alma, Wash.
Payette-Boise, Caldwell, Idaho.
Pecos, Carlsbad, N. Mex.
Rio Hondo, Roswell, N. Mex.

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[a] Decision of the Comptroller of the Treasury.

Salt River Valley, Phoenix, Ariz.
Strawberry Valley, Spanish Fork, Utah.
Sunnyside, North Yakima, Utah.
Tieton, North Yakima, Wash.
Umatilla, Hermiston, Oreg.
Uncompahgre, Montrose, Colo.
Williston, Williston, N. Dak.
Yuma County, Yuma, Ariz.

LITIGATION.

ARIZONA.

Salt River project.—July 8, 1904, suit was instituted in the district court of the third judicial district of Arizona to cause the removal of Charles W. Williams and his saloon from the land withdrawn from entry for the Salt River project. Immediately after filing the complaint a temporary injunction was obtained restraining Williams from maintaining a saloon in the place mentioned or from entering upon the reserved land for any purpose whatsoever without the authority of the Secretary or his authorized agent. Upon service of the temporary injunction Williams removed his saloon. On November 10 judgment by default was obtained making perpetual the injunction formerly issued.

March 1, 1906, suit was instituted in the United States court of the third district of Arizona against C. C. Gish who had established and was maintaining a saloon about 7 miles above Roosevelt, Ariz. On March 2 a temporary writ of injunction was obtained restraining him from continuing his saloon business on the lands in question, and on March 3 the writ was served on Gish, who thereupon ceased to operate the saloon and ceased to sell and dispose of intoxicating liquors at that point.

In October, 1905, James R. Thorpe, contractor for construction of a telephone system in connection with the Salt River project, Arizona, brought suit in the United States circuit court of Colorado, claiming payment due for certain extras under the said contract. The case was set for hearing on June 24, 1906, at Denver, Colo. A decision in favor of the United States was rendered on August 30, 1906.

CALIFORNIA.

Klamath project.—In April, 1905, the United States brought suit in the United States circuit court for Oregon to enjoin the Klamath Canal Company from diverting the waters of Upper Klamath Lake for purposes of irrigation on the ground that such diversion interfered with the navigability of interstate waters. In the same month a temporary injunction was secured restraining the company from diverting the waters of Klamath Lake, and the case was set for trial on May 24, 1905.

On May 7, 1905, a compromise was effected on the terms proposed by the United States and on May 22, 1906, formal contract was entered into.

Yuma project.—November 8, 1905, Miller & Peasley, contractors on dike construction, received notice of an injunction suit by the Irrigation Land and Improvement Company whose land it was proposed to cross with the dike, and with whom it had not been possible to make an arrangement for purchase of right of way. The commissioner of the Territorial court of Arizona granted a temporary injunction, but dissolved it on November 16. On November 24, 1905, the Irrigation Land and Improvement Company filed a bill of complaint against the Secretary of the Interior in the supreme court, District of Columbia, alleging that the United States was in competition with the company's system as a result of the Yuma project, that the Secretary was exercising powers not conferred by the reclamation act, that the act was unconstitutional, and praying for an injunction restraining the Secretary of the Interior from further prosecuting the work on the Yuma project. A demurrer was filed May 18, 1906, by the United States. On same date a stipulation was filed by both parties agreeing to submit the case first upon the single question of jurisdiction. Decree was filed June 14, 1906, the court finding that the subject-matters of the complaint are not within the jurisdiction of the court and ordering that the complaint be dismissed for want of jurisdiction, at plaintiff's cost. An appeal was allowed to the court of appeals of the District of Columbia.

COLORADO.

Colorado River projects.—May 1, 1905, the United States brought an action to have forfeited a railroad right of way through Gore Canyon in Grand County, Colo., claimed by the Denver, Northwestern and Pacific Railway Company, under the provisions of the act of Congress approved March 3, 1875, and as grantee of the Colorado Railway Company. The suit was dismissed without prejudice on motion by the United States November 29, 1905.

On May 6, 1905, an action was brought by the United States in the United States circuit court of Colorado against the Denver, Northwestern and Pacific Railway Company, the Colorado-Utah Construction Company, and their officers and directors, seeking to restrain them from constructing a railroad through Gore Canyon. On September 5, 1905, the motion for an injunction was denied.

Uncompahgre Valley project.—On September 29, 1905, suit was brought against the engineer in charge of the Uncompahgre Valley project by the receiver of the Denver Savings Bank, Denver, Colo., to secure possession of property mortgaged to the bank by the Taylor-Moore Construction Company, defaulting contractors for construction of the Gunnison tunnel. A writ of replevin was issued October 5, 1905, but the case was closed by an order issued October 10, 1905, restraining the plaintiff from interference with the said property.

IDAHO.

Payette-Boise project.—In April, 1906, injunction proceedings were instituted by Mrs. R. E. Green against Conway & Wilhite, contractors on the Payette-Boise project, Idaho, across whose land right of way was claimed by the United States under the act of August 30, 1890 (26 Stat. L., 391). A hearing was had by the district judge of Canyon County, in chambers, on April 14, and on April 28 he decided that the act above referred to did not reserve to the United States rights of way as claimed, and a temporary injunction was granted Mrs. Green restraining the contractors from further work, pending a determination of the case on its merits.

In October, 1906, R. E. Green filed a complaint against the same contractors in the State court which was removed to the United

States district court. On October 31, 1906, the court held that the United States was entitled to right of way and dismissed the case.

NEBRASKA.

North Platte project.—In October, 1904, an application for water right was filed under the laws of the State of Nebraska. H. G. Leavitt claimed that he was entitled to the prior approval of an application filed by him and the State board of irrigation decided against Leavitt's contention on February 14, 1905. Leavitt appealed to the district court, making the Secretary of the Interior one of the defendants. The case was removed to the district court of the United States, where it is now pending.

NEVADA.

Truckee-Carson project.—July 31, 1905, Murray F. Vandall, claiming to be the owner of land bordering on Lake Tahoe, filed in the superior court of California in and for the city and county of San Francisco a complaint against Edward Malley, contractor for construction of the Lake Tahoe outlet and regulating works, Truckee-Carson project, Nevada, and praying that he be perpetually enjoined from proceeding with the contemplated construction of the work. On the same date the court issued an order to show cause why a writ of injunction should not issue, and also an order restraining the contractor from proceeding with the work. August 3, 1905, the court modified the injunction so as to permit the contractor to construct the work to within 100 feet of the lake. Immediately thereafter another proceeding was instituted in the superior court of Placer County in the name of Tevis *v.* Malley, and an injunction obtained against the contractor. Under the law of California it is possible to obtain an injunction in the superior court of any county in the State to restrain work in any part of the State, and complaints were so drawn that the cause could not be removed to the Federal courts. There are 88 superior courts in the State and more than 40 owners of property along the shore of Lake Tahoe.

In order that the Federal questions involved might be directly and promptly determined it was considered best to cancel the contract, which was done with the consent of the contractor.

Further action in this matter is now under consideration.

NEW MEXICO.

Hondo project.—In August, 1905, the Roswell National Bank, which was alleged to have advanced considerable sums to the Taylor-Moore Construction Company, defaulting contractors on the above project, brought a foreclosure suit on a chattel mortgage, to obtain possession of certain equipment employed in the work by the contracting company, the petition praying that the engineers of the Reclamation Service be enjoined from further use of any of the tools or implements belonging to the Taylor-Moore Company, and that judgment be rendered against the United States in the sum of $24,000. The court declined to issue the order.

OREGON.

Umatilla project.—In the construction of the feed canal it became necessary to acquire right of way over and across property owned by

Joseph Ramos, but liberal offers made by the United States were refused by him. Steps were at once taken to secure the land by condemnation proceedings, but before the date fixed for the hearing a compromise was reached and an agreement entered into whereby the United States secured the land required at practically the original offer.

WASHINGTON.

Yakima district.—In June, 1906, the United States filed in the circuit court of the eastern district of Washington a complaint alleging that the Cascade Canal Company had without authority and contrary to law constructed a dam at or near the outlet of Lake Kachess, a lake situated in the Cascade Mountains, Kittitas County, Wash.; that the Government intended to use Lake Kachess as a storage reservoir under the authority of the special act of the legislature of the State of Washington, approved March 4, 1905, and that defendant's operations interfered with and made impossible such use. The Government prayed that an order be issued permanently enjoining the maintenance of said dam upon public lands and the further flooding of public lands and destruction of timber.

The case is still pending.

PURCHASES OF RIGHTS OR PROPERTY.

Section 7 of the reclamation act provides that where in carrying out the provisions of the act it is necessary to acquire any rights or property, the Secretary of the Interior may acquire them for the United States by purchase or by condemnation through judicial process.

The following is the list of purchases thus far made under this section of the act:

Purchases of rights or property.

SALT RIVER PROJECT, ARIZONA.

Vendor.	Description.	Consideration.	Date of deed.
Duey, Jacob S., and wife	SE. ¼ NW. ¼ and NE. ¼ SW. ¼ sec. 22, T. 4 N., R. 12 E., G. and S. R. M., 80 acres, also water rights, ditches, etc.	$2,200	Jan. 11, 1906
Do	An undivided one-fourth interest in S. ½ NE. ¼ and N. ½ SE. ¼ sec. 22, T. 4 N., R. 12 E., G. and S. R. M., 160 acres, Gila County, Ariz., also right in Gordon ditch.	600	June 4, 1906
Egan, Nicholas	An undivided one-fourth interest in N. ½ SE. ¼ and S. ½ NE. ¼ sec. 22, T. 4 N., R. 12 E., G. and S. R. M., Arizona, also right in Gordon ditch.	500	June 8, 1906
Fisher, Wm. D	SE. ¼ NE ¼ sec. 28, and SW. ¼ NW. ¼ sec. 27, T. 5 N., R. 11 E., G. and S. R. M., Arizona.	1,050	Jan. 29, 31, 1906.
Griffin, Chas. C., and wife	SE. ¼ NE. ¼ sec. 26, and SW. ¼ NW. ¼ and W. ½ SW. ¼ Sec. 25, T. 4 N., R. 13 E., G. and S. R. M., Arizona, also water rights, ditches, improvements, etc., including Hazard ditch.	1	[a] Oct. 2, 1905
Do	SW. ¼ NE. ¼, N. ½ SE. ¼ and SE. ¼ SE. ¼ sec. 26, T. 4 N., R. 13 E., G. and S. R. M., also water rights, ditches, and improvements, including Hazard ditch.	6,000	Oct. 2, 1905
Nelson, Josephine C	An undivided one-fourth interest in S. ½ NE. ¼ and N. ½ SE. ¼ sec. 22, T. 4 N., R. 12 E., G. and S. R. M., Arizona, 160 acres, also right in Gordon ditch.	600	June 13, 1906
Zschoegner, Harry, and wife	An undivided one-fourth interest in S. ½ NE. ¼ and N. ½ SE. ¼ sec. 22, T. 4 N., R. 12 E., G. and S. R. M., Arizona, 160 acres, also right in Gordon ditch.	500	June 4, 1906

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[a] Relinquishment.

Purchases of rights or property—Continued.

YUMA PROJECT, CALIFORNIA-ARIZONA.

Vendor.	Description.	Consideration.	Date of deed.
Bruns, Henry	Improvements and rights on NE. ¼ sec. 12, T. 7 S., R. 22 W., G. and S. R. M.	$1,000	July 16, 1906
Cavanagh, R. W	Possessory rights to land in sec. 30, T. 15 S., R. 24 E., S. B. M., including all improvements.	500	[a] Aug. 13, 1906
Dixon, James, and wife	Improvements and rights on SE. ¼ NE. ¼ and NE. ¼ SE. ¼ sec. 11, and W. ½ NW. ¼ sec. 12, T. 7 S., R. 22 W., G. and S. R. M.	2,000	June 30, 1906
Elliott, Chas. W	Possessory rights to SE. ¼ sec. 15, T. 7 S., R. 22 W., G. and S. R. M., with all improvements, 160 acres.	100	July 30, 1906
Leposky, Ike	Improvements and rights on E. ½ NE. ¼ and NE. ¼ SE ¼ sec. 1, T. 7 S., R. 22 W., G. and S. R. M.	700	July 17, 1906
McClelland, George	Improvements and rights on E. ½ SE. ¼ sec. 12 and N. ½ NE. ¼ sec. 13, T. 7 S., R. 22 W., G. and S. R. M.	2,000	Do.
McCormick, Hannah	Possessory rights to S. ½ SE. ¼ sec. 11 and S. ½ SW. ¼ sec. 12, T. 7 S., R. 22 W., G. and S. R. M., 160 acres, including all improvements.	200	Aug. 8, 1906
McPhaul, May, and husband	Part of block 47, town of Yuma, 1.52 acres, Arizona.	100	Feb. 14, 1906
Myers, J. H	Improvements and rights on E. ½ NW. ¼ and NW. ¼ NE. ¼ sec. 22 and SW. ¼ SE. ¼ sec. 15, T. 7 S., R. 22 W., G. and S. R. M.	200	July 30, 1906
Owen, Dexter	Strips of land included in H. E. No. 4102, Tucson series, Arizona, Jan. 20, 1902, for lots 5 and 6, sec. 28, and lots 1, 2, and 3, sec. 33, T. 8 S., R. 24 W., G. and S. R. M.	120	July 17, 1905
Pepin, Emma J	Improvements and rights on SW. ¼ SW. ¼ sec. 30 and W. ½ NW. ¼ and NW. ¼ SW. ¼ sec. 31, T. 6 S., R. 21 W., G. and S. R. M.	500.00	July 19, 1906
Ricks, G. L., and wife	About 12.2 acres in S½SE¼ sec. 28, T. 16 S., R. 22 E., S. B. M.	430.50	July 7, 1906
Sass, E. S., Fischer, F. X., Fraser, W. L., Sass, J. H.	Sass mining claims	6,000.00	Mar. 24, 1905
Stratton, Thos., and wife	Part of block 49, town of Yuma, 1.52 acres	100.00	Feb. 6, 1905
Do	Parts of blocks 36, 46, 48, and W½ block 51, for right of way for dike.	150.00	Sept. 7, 1905

KLAMATH PROJECT, CALIFORNIA-OREGON.

Vendor.	Description.	Consideration.	Date of deed.
Klamath Canal Co	Properties and rights	$150,000.00	Apr. 23, 1906
Klamath Falls Irrigating Co.	Purchase of property and rights as follows: All that certain irrigation ditch or canal, and water rights therefor, owned and operated by said corporation in Klamath County, Oreg., together with all laterals, feeders, flumes, head gates, sluiceways, rights of way and all other structures and property and rights, both real and personal, in any way thereto pertaining, attached to or used in connection therewith, and also all its estate, right, title, and interest, at law and equity, therein and thereto, excepting, however, from said rights of way, the right of way occupied by the ditch or canal of the Klamath Falls Irrigating Company, over and through the following-described property: The S. ½ SE. ¼ SW. ¼ sec. 28, and the N. ½ NE. ¼ sec. 33, T. 38 S., R. 9 E., W. M., in Klamath County, Oreg., and the E. ½ SE. ¼ sec. 29; the W. ½ SW. ¼ and the N. ½ SE. ¼ SW. ¼ sec. 28, T 38 S. R. 9 E., W. M., in Klamath County, Oreg. Also water rights as set forth in deed of said corporation dated July 28, 1906.	47,530.65	July 28, 1906

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[a] Recorded.

Purchases of rights or property—Continued.

PAYETTE-BOISE PROJECT, IDAHO.

Vendor.	Description.	Consideration.	Date of deed.
Brandt, Herman L., and wife.	SW. ¼ sec. 5, T. 2 N., R. 2 W., B. M., 160 acres.	$2,400.00	June 23, 1906
Do	W. ½ SE. ¼ sec. 21, T. 3 N., R. 3 W., B. M., 80 acres	1,200.00	June 23, 1906
Brandt, Herman L., and wife.	160 acres, SE. ¼ sec. 34, T. 3 N., R. 3 W., B. M.	2,400.00	June 23, 1906
Carpenter, Lucien N. B., and wife.	N. ½ NE. ¼ SE. ¼ sec. 33, T. 3 N., R. 3 W., B. M.	300.00	Apr. 13, 1906
Conway, Wm. H	SW. ¼ sec. 22, T. 3 N., R. 3 W., B. M	2,400.00	Apr. 14, 1906
Crawford, Lincoln H., and wife.	Lot 3 and SE. ¼ NW. ¼ sec. 1, T. 2 N., R. 3 W., B. M., 81.89 acres.	1,228.35	Apr. 7, 1906
Duval, William J	SW. ¼ sec. 35, T. 3 N., R. 3 W., B. M., 160 acres.	12,000.00	Aug. 23, 1906
Gott, Daniel E., and wife	70 acres in W. ½ NE. ¼ sec. 1, T. 2 N., R. 3 W., B. M.	6,560.00	Apr. 18, 1906
Harris, Chas. H., and wife	101 acres, more or less, W. ½ SW. ¼ sec. 1, T. 2 N., R. 3 W., B. M., and part of NW. ¼ NW. ¼ sec. 12, T. 2 N., R. 3 W., B. M., also a strip of land 100 feet wide.	10,220.00	Apr. 20, 1906
Hasbrouck, William L	NW. ¼ sec. 21, T. 3 N., R. 3 W., B. M., 160 acres.	2,400.00	Apr. 6, 1906
Jessee, Wm. H	17 acres in SW. ¼ SE. ¼ sec. 2, T. 2 N., R. 3 W. B. M.	255.00	Apr. 2, 1306
Larson, O. E	22 acres in NW. ¼ NE. ¼ sec. 8, T. 2 N., R. 2 W., B. M.	330.00	May 18, 1906
McMahin, Jean	137 acres in SE. ¼ sec. 29, T. 3 N., R. 3 W., B. M.	2,055.00	Apr. 18, 1906
Partridge, H. A., and wife	S. ½ sec. 28, T. 3 N., R. 3 W., B. M., 320 acres	4,000.00	Apr. 6, 1906
Do	S. ½ sec. 28, T. 3 N., R. 3 W., B. M., 320 acres.	4,000.00	Apr. 16, 1906
Pleasants, Wm. A., and wife.	97 acres in lots 4 and 5, SE. ¼ NW. ¼, and SW. ¼ NE. ¼ sec. 6, T. 2 N., R. 2 W., B. M., with a strip of land 100 feet wide paralleling the flow line of Deer Flat reservoir.	1,455.00	July 9, 1906
Polley, Lorenzo C., and wife	118 acres comprising E. ½ SE. ¼ and part of S. ½ NE. ¼ sec. 19, T. 3 N., R. 3 W., B. M.	1,770.00	May 24, 1906
Poston, Thos. D., and wife	NE. ¼ sec. 20, T. 3 N., R. 3 W., B. M., 160 acres.	2,400.00	Apr. 7, 1906
Rathfon, D. W	122 acres in SE. ¼ SE. ¼ sec. 33, T. 3 N., R. 3 W., B. M., and lot 1 of sec. 4, T. 2 N., R. 3 W., B. M., and parts of lot 2 of said sec. 4.	1,830.00	Apr. 5, 1906
Richards, Hattie A	10 acres in NE. ¼ SE. ¼ sec. 12, T. 2 N., R. 3 W., B. M.	1,000.00	Apr. 3, 1906
Ridenbaugh, Mary E	E. ½ SE. ¼ sec. 6, T. 2 N., R. 2 W., B. M., 80 acres.	1,200.00	Mar. 9, 1906
Scism, Samuel C., and wife	27 acres in N. ½ NE. ¼ sec. 18, T. 2 N., R. 2 W., B. M.	2,700.00	Apr. 19, 1906
Smith, Thos., and wife	81.7 acres in lot 4, and SW. ¼ NW. ¼ sec. 1, T. 2 N., R. 3 W., B. M.	5,738.00	Apr. 2, 1906
Steele, Orville R	Damages to March Morning placer claim in sec. 25, T. 9 S., R. 23 F., B. M.	800.00	[a] July 24, 1906
Sundman, Lars F., and wife	E. ½ SE. ¼ sec. 21, T. 3 N., R. 3 W., B. M., 80 acres.	1,200.00	Apr. 23, 1906

MINIDOKA PROJECT, IDAHO.

Vendor.	Description.	Consideration.	Date of deed.
Hall, George W. and Agnes	Parts of Bancroft, Spring Bar, and Durango placer mining claims, situated in lots 1, 2, 3, and 4, sec. 22; lots 1, 2, and 3, sec. 23; lot 4, sec. 26; lots 2 and 3 and SE. ¼ NW. ¼ sec. 25, T. 9 S., R. 27 E., B. M., 175.2 acres.	$5,500.00	May 23, 1906

LOWER YELLOWSTONE PROJECT, MONTANA AND NORTH DAKOTA.

Vendor.	Description.	Consideration.	Date of deed.
Davies, David	Release of claims for damages to improvements on land situated in NW. ¼ SE. ¼ sec. 34, T. 19 N., R. 57 E., M. P. M., covered by homestead entry No. 2389 of May 31, 1905.	$500.00	[b] Sept. 30, 1905
Nelson, John A	Damages by reason of construction of canal through SW. ¼ sec. 24, T. 19 N., R. 57 E., M. P. M.	200.00	[a] July 25, 1906
Nelson, Nels Henry, and wife.	7.7 acres in lot 1, sec. 35, T. 19 N., R. 57 E., M. P. M.	92.40	July 31, 1905
Thomas, Albert H., and wife.	NW. ¼ sec. 28, T. 20 N., R. 58 E., M. P. M., 160 acres.	1,600.00	Do.

[a] Contract date.

[b] Release.

Purchases of rights or property—Continued.

NORTH PLATTE PROJECT, NEBRASKA-WYOMING.

Vendor.	Description.	Consideration.	Date of deed.
Baker, Chas. F., and wife....	E. ½ SE. ¼ sec. 20, SW. ¼ SW. ¼ sec. 21, and NW. ¼ NW. ¼ sec. 28, T. 29 N., R. 84 W., Wyoming, 120 acres; also assignment of State lease of sec. 16, T. 29 N., R. 84 W.	$2,875.00	Feb. 19, 1906
Bohannon, Wm. B., and wife.	E. ½ NE. ¼ sec. 20 and W. ½ NW. ¼ sec. 21, T. 29 N., R. 84 W., 6th P. M., 160 acres, Wyoming.	1,700.00	[a] Feb. 24, 1906
McCartney, Mary A., and husband.	W. ½ SW. ¼ of NE. ¼ NE. ¼ sec. 11, T. 25 N., R. 63 W., 6th P. M., 5 acres.	1.00	July 22, 1905
Meneice, Albert, and wife....	SW. ¼ sec. 6, T. 29 N., R. 85 W., 6th P. M., 158.83 acres.	1,280.00	Feb. 24, 1906
Murphy, Margarette M., and husband.	Lots 1, 2, 3, and 4, sec. 10, T. 26 N., R. 65 W., 168.66 acres, 6th P. M.	2,000.00	Nov. 6, 1905
Ray, Emma..................	NW. ¼ sec. 7, T. 29 N., R. 85 W., 160 acres, 6th P. M., Wyoming.	1,180.00	Feb. 24, 1906
Roberts, Art................	SE. ¼ sec. 6, T. 29 N., R. 85 W., 160 acres, 6th P. M., Wyoming.	1,600.00	Feb. 25, 1906

TRUCKEE-CARSON PROJECT, NEVADA.

Central Pacific Railway Co ..	T. 18 N., R. 25 E.: SE. ¼ SW. ¼ and S. ½ SE. ¼ sec. 17; all sec. 21; SW. ¼ NW. ¼, S. ½ sec. 23; N. ½ NE. ¼ sec. 25; NE. ¼ NE. ¼ and W. ½ NW. ¼ sec. 27; SE. ¼ NE. ¼, NE. ¼ SE. ¼, and S. ½ SE. ¼ sec. 29; N. ½ and SW. ¼ sec. 33; SW. ¼ and SW. ¼ SE. ¼ sec. 35. T. 17 N., R. 25 E.: SW. ¼ NE. ¼ lot 4 of NW. ¼; S. ½ NW. ¼ and S. ½ sec. 1; NW. ¼ SW. ¼ sec. 3; E. ½ NE. ¼ and SE. ¼ SE. ¼ sec. 11; NE. ¼, E. ½ NW. ¼ and SW. ¼, sec. 13; NE. ¼ SE. ¼ and S. ½ SE. ¼ sec. 15; NE. ¼ NE. ¼ and SW. ¼ NE. ¼ sec. 23. T. 17 N., R. 23 W.: S. ½ NE. ¼, SE. ¼ NW. ¼ and S. ½ sec. 3; NE. ¼, S. ½ NW. ¼, and S. ½ sec. 9; all secs. 11, 15, 17, 19; N. ½, NE. SW. and SE. ¼ sec. 21; W. ½ NE., NW. ¼ and S. ½, sec. 23; W. ½ NW. and NW. ¼ SW. ¼ sec. 25; all sec. 27; W. ½ NW. ¼, sec. 35. T. 17 N., R. 22 E.: SE. ¼ SE. ¼ sec. 13; NE. ¼ and NW. ¼ SE. ¼ sec. 25. 9,095.16 acres, at $1.25 per acre; M. D. M.	$11,368.95	Dec. 24, 1905
Do........................	T. 19 N., R. 26 E.: S. ½ SW. ¼ and SE. ¼, sec. 33.. T. 18 N., R. 26 E.: S. ½ NW. ¼, W. ½ SE. ¼, and SW. ¼, sec. 3; lot 1 of NE. ¼, SE. NE. and SE. ¼, sec. 5; N. ½ SW. ¼, N. ½ SE. ¼, and SW. ¼ SE. ¼ sec. 9; SE. ¼ NE. ¼ and E. ½ SE. sec. 7; N. ½, SW. ¼, and N. ½, SE. ¼, sec. 17; NE. ¼, lot 4 of SW. ¼, SE. SW. and SE. ¼, sec. 19. M. D. M.; 2,478.26 acres, at $1.25 per acre.	3,097.82	Do.

HONDO PROJECT, NEW MEXICO.

Pecos Irrigation Company...	Property and rights..........................	$150,000	Dec. 18, 1905

BELLE FOURCHE PROJECT, SOUTH DAKOTA.

Barnett, H. L., and wife......	Part of S ½ SE. ¼ sec. 30, T. 9 N., R. 3 E., B. H. M., 9.56 acres.	$286.80	June 9, 1906
Broomfield, David, and wife.	10.25 acres in SE. ¼ SW. ¼ sec. 25, T. 9 N., R. 2 E., main supply canal, Butte County.	307.50	Feb. 26, 1906
Cattle Co., J. M.............	160 acres in sec. 35, T. 9 N., R. 3 E., B. H. M., NE. of a line extending from SE. corner to NW. corner of section.	1,600	Oct. 23, 1905
Gilbert, J. A., and wife.......	13.11 acres in NE. ¼ SW. ¼ and N. ½ SE. ¼ sec. 25, T. 9 N., R. 2 E.	393.30	Oct. 17, 1905
Hall, Richard E., and wife....	30.35 acres in NW. ¼ NE. ¼ sec. 2, T. 8 N., R. 2 E.	1,468.20	Jan. 19, 1906
Hammond, Thos. B., and wife	61.53 acres in SW. ¼ sec. 36, T. 9 N., R. 2 E., and E. ½ NE. ¼ sec. 35, T. 9 N., R. 2 E., Butte County.	2,780.40	May 14, 1906

[a] Quitclaim.

Purchases of rights or property—Continued.

BELLE FOURCHE PROJECT, SOUTH DAKOTA—Continued.

Vendor.	Description.	Consideration.	Date of deed.
Jones, John R	Right of way over NW. ¼ SE. ¼ and NE. ¼ SW. ¼ sec. 30, T. 9 N., R. 3 E., B. H. M., 9.26 acres.	$277.80	Mar. 13, 1906
Sellers, Samuel W. P., and wife.	6.3 acres in NW. ¼ SW. ¼ sec. 30, T. 9 N., R. 3 E., B. H. M.	189.00	Oct. 25, 1905
State of South Dakota	Sec. 36, T. 9 N., R. 3 E., B. H. M., 640 acres	6,708.00	[a]July 16, 1906
Stella, George, and wife	49.49 acres in E. ½ NE. ¼ sec. 2, T. 8 N., R. 2 E., B. H. M.	2,969.40	Jan. 4, 1906
Wright, Harry P	Part of NW. ¼ NW. ¼ sec. 17, and NE. ¼ NE. ¼ sec. 18' T. 8 N., R. 4 E., B. H. M., 17.01 acres.	680.40	June 9, 1906

YAKIMA DISTRICT, WASHINGTON.

Vendor.	Description.	Consideration.	Date of deed.
Howson, Josiah B., and wife.	NE. ¼ NE. ¼ and E. ½ NW. ¼ sec. 10, T. 20 N., R. 15 E., W. M., 120 acres.	$3,000	June 22, 1906

SHOSHONE DISTRICT, WYOMING.

Vendor.	Description.	Consideration.	Date of deed.
Brundage, Edith J., and husband.	S. ½ SE. ¼ sec. 23, and S. ½ NW. ¼ and NE. ¼ sec. 26, T. 52 N., R. 103 W., 6th P. M., 320 acres, improvements and water rights.	$11,000	Mar. 7, 1906
Martin, Andrew J., and wife	NE. ¼ NE. ¼ sec. 18, E. ½ SE. ¼ sec. 7, and NW. ¼ SW. ¼, NE. ¼ SW. ¼, SE. ¼ NW. ¼, and S. ½ NE. ¼ sec. 8, T 52 N., R. 103 W., 6th P. M., 320 acres.	9,500	Mar. 28, 1906
Riddle, Stilley T., jr., and wife, and Riddle, Prestley.	NW. ¼ sec. 25, T. 52 N., R. 103 W., 6th P. M., 160 acres, with all water rights, houses, fences, and all improvements.	5,500	June 19, 1906
Tinkcom, Dallas A., and wife.	NW. ¼ sec. 24, SW. ¼ SW. ¼ sec. 13, SE. ¼ SE. ¼ sec. 14, and E. ½ NE. ¼ sec. 23, T. 52 N., R. 103 W., 6th P. M., 320 acres.	10,000	Apr. 21, 1906
Westfall, Chester C., and wife.	S. ½ SE. ¼ and S. ½ SW. ¼ sec. 9, T. 52 N., R. 103 W., 6th P. M., and damages for loss of improvements, 160 acres.	535	[b]Apr. 3, 1906
Wilder, Eugene, et al	W. ½ SW. ¼ sec. 25. SE. ¼, E. ½ SW. ¼, NW. ¼ SW. ¼ sec. 26, and N. ½ NE. ¼ sec. 35, T. 52 N., R. 103 W., 6th P. M., 440 acres, excepting right of way 132 feet wide through NE. ¼ NE. ¼ sec. 35 and SW. ¼ SW. ¼ sec. 25; also water rights, houses, fences, and all improvements.	20,000	June 21, 1906

[a] 16 patents.

[b] Relinquishment of homestead entry acknowledged by register of Lander land office.

LABOR CONDITIONS.

One of the most serious and complex problems with which the engineers have had to deal has been that of labor. Labor has been not only scarce but inefficient. The great amount of railroad building in the West has caused an exceptional demand for all classes of laborers and has made it almost impossible to retain the men for long periods. Men will work on a job for a short time and then will leave on the slightest pretext and move on to the next contractor's camp. The pay rolls on the Gunnison tunnel, for instance, show that about 25 per cent of the men are steadily employed, the remainder of them working for periods varying from a portion of a day to thirty days. As a rule the pay rolls on this project contain about 800 or 900 names a month, while the number of men actually employed at one time probably does not exceed 450. This condition has confronted the contractors as well as the engineers who are directing the work carried on by force account. The contractors have been obliged to ship most of the laborers from the large centers and in many cases the men do not work long enough to repay the money advanced for their transportation expenses.

The scarcity of labor has naturally decreased its effectiveness. The men can not be successfully urged to greater exertions when they can get work so readily at other points. If they think they are being pushed too hard they stop work without notice.

The eight-hour law has also been a source of difficulty and increased expense. Strict enforcement of the eight-hour law, as practiced on the reclamation work, is adding materially to the cost of the irrigation works. It has not been found that the same amount of rock can be excavated, or earth can be moved, or concrete placed, in an eight-hour day as in one of nine or ten hours. But the laborer expects to earn as much in eight hours on Government work as he does in a longer day in a railroad camp, and he drifts away whenever there is material difference in the amount of the daily wage. It has not yet become evident that the enforced additional leisure is appreciated. The general feeling among laborers appears to be that work is work, so much per hour, and the ordinary laborer prefers to be at work—pay being proportional to hours of work—rather than to be forced into idleness, especially with the uncongenial surroundings of a construction camp remote from home or places of amusement. This appears to be particularly true for the conditions that prevail during the summer in the Southwest, where there is more complaint of heat and hot weather while men are idle than while they are at work.

TRANSPORTATION OFFICE.

On account of the great amount of material that must be transported to the various projects it has been found advisable to establish a central transportation office to supervise all dealings with the railroads. The duties of this office comprise: (1) the examination of all accounts rendered by the railroads and (2) the making of special arrangements with the railroads for the transportation of material needed on reclamation projects. As a great amount of material is bought by the Reclamation Service f. o. b. cars at the factory, a large sum has been saved through the special rates obtained. The railroads listed below have made agreements with the Reclamation Service for transportation of freight. These agreements provide for the lowest of the following rates: (*a*) Any special commodity rate applying to the particular commodity transported; (*b*) Pacific coast terminal rates as shown in the published transcontinental tariffs; (*c*) tariff rates less land-grant deductions; (*d*) one-half regular published local class rates, or one-half the company's earnings on basis of through class rates, depending on whether the shipment is a local or through shipment.

Atchison, Topeka and Santa Fe Railway.
Chicago, Burlington and Quincy Railway.
Chicago and Alton Railway.
Chicago Great Western Railway.
Chicago, Milwaukee and St. Paul Railway.
California Northeastern Railway.
Chicago, Rock Island and Pacific Railway.
Chicago, Rock Island and Gulf Railway.
Chicago, Rock Island and El Paso Railway.
Chicago and Northwestern Railway.
Fort Worth and Rio Grande Railway.
Great Northern Railway.
Gila Valley, Globe and Northern Railway.
Illinois Central Railroad.
Minneapolis, St. Paul and Sault Ste. Marie Railway.

Maricopa and Phoenix and Salt River Valley Railroad.
Northern Pacific Railway.
Oregon Railroad and Navigation Company.
Oregon Short Line Railroad.
Paris and Great Northern Railroad.
St. Louis, Kansas City and Colorado Railroad.
St. Louis, San Francisco and Texas Railway.
St. Louis and San Francisco Railroad.
San Pedro, Los Angeles and Salt Lake Railroad.
Southern Pacific Company (Atlantic System).
Southern Pacific Company (Pacific System).
Union Pacific Railroad.
Wabash Railroad.

The Missouri Pacific Railway and the St. Louis, Iron Mountain and Southern Railway have made agreements providing for the lowest of the following rates to Pueblo, Colo., only: (*a*) Any special commodity rate applying to the particular commodity transported; (*b*) tariff rates less land-grant deductions; (*c*) one-half regular published local class rates, or one-half the company's earnings on basis of through class rates, depending on whether the shipment is a local or through shipment.

The Denver and Rio Grande Railroad has made agreements providing for the lowest of the following rates: (*a*) Any special commodity rate applying to the particular commodity transported; (*b*) one-half regular published local class rates. These rates apply from Pueblo and Denver to Cedar Creek, Montrose, and Delta, Colo., and from Salt Lake City, Ogden, Denver, and Pueblo to Castilla, Utah.

All of the above contracts apply on machinery, material, and supplies used in reclamation work, except clothing, provisions, and supplies for the use of or consumption by the men, and articles produced or carried in stock in the local markets. Contractors' material from a project is subject to same provisions, concessions not to exceed amount accruing on same to the project.

During the last fiscal year the following concessions have been obtained:

The California Northeastern Railroad has granted a rate of 21¼ cents a hundred pounds on cement from Weed to Klamath Falls. The commercial rate is 25 cents a hundred pounds.

The Southern Pacific and the Atchison, Topeka and Santa Fe railroads have made a rate of $6 a ton for oil shipped from Bakersfield, Cal., to Mesa, Ariz. The commercial rate is $8 a ton.

The Atchison, Topeka and Santa Fe Railway has granted a rate of 30 cents per hundred on lumber in carload lots from eastern Texas points to Carlsbad. The commercial rate is 45 cents a hundred. This road has also granted a rate of 15 cents per hundred on cement in carload lots from Iola, Kans., and Independence to Carlsbad. The commercial rate is 35 cents a hundred. It has also allowed a rate of 70 cents per hundred on cement in carload lots from Portland, Colo., to Globe, Ariz., antedated to include all cement purchased of the Portland Cement Company, and shipped in July, August, September, and October, 1904. The commercial rate is $1.29 per hundred.

The Southern Pacific Company has made a rate which applies to Mesa, Ariz., via Santa Fe, and which will be applied to Globe, Ariz., via the Southern Pacific. It has also allowed stock in carload lots at 50 per cent of commodity rate, this commodity rate being lowest commercial rate. It has also granted half of class rates on shipments of supplies, groceries, clothing, etc., from San Francisco and Sacramento and Reno to Hazen.

The Oregon Short Line decided to carry stock in carloads at 50 per cent of commodity rate, this commodity rate being lowest commercial rate. It also made a deduction on cement from Salt Lake to Minidoka from 37 cents to 18.5 cents.

The Chicago, Burlington and Quincy Railway decided that stock in carloads should have a concession of 50 per cent of commodity rate, this commodity rate being lowest commercial rate. It also granted a rate on cement, Chicago to Cody, of 41 cents per hundred. The commercial rate is 71 cents per hundred.

The Chicago and Northwestern Railway has made a rate of 33.66 cents per hundred pounds on cement in carload lots from Chicago to Casper, Wyo. The commercial rate is 57½ cents.

The Denver and Rio Grande has made a rate of $1 per ton on coal, carload lots, from Somerset to Montrose and Cedar Creek. The commercial rate is $1.85 per ton. It has granted an extension of contract to all articles certified to as being not obtainable in local market. This is to include fuse, candles, etc. It has also agreed to do switching between all points in Uncompahgre Valley at $3 a car. The commercial rate is $5 a car.

The Great Northern Railway has made a rate of 50 per cent of commercial rates on lumber and piling, carload lots, from all lumber-producing points on the Great Northern east of Spokane to points on the Sun River, Milk River, Lower Yellowstone, and Williston projects.

The Elgin, Joliet and Eastern Railroad has granted a rate of 2 cents per hundred on cement for Payette-Boise points, South Chicago to Joliet. The commercial rate is 2½ cents per hundred.

All the western lines have decided to allow half rates for employees and families and half rates for laborers. These concessions amount to over $2,500 a month, direct to engineers and assistants, besides amount saved Service on laborers.

The California Northeastern Railway has granted a rate of 21¼ cents per hundred pounds on cement from Weed to Klamath Falls—reduction from 25 cents. This saves about $1,500 on present cement contract.

The total expenditures for freight during the last fiscal year amounted to $85,741.35. The commercial charges on the shipments covered by the above expenditure would have been $130,097.44, showing a saving of $40,307.51 by reason of the agreements with the railroads. In addition the transportation office has received from the railroads $3,954.21 on account of land-grant roads, $94.37 on account of loss and damage, and $7,360.91 on account of contractors' freight—a total saving of $51,717. Claims for $13,122 on account of contractors' freight have been filed but not paid.

FINANCES.

RECEIPTS.

The reclamation act provides that the net proceeds from the sales of public lands in thirteen States and three Territories, including the fees and commissions in excess of allowances to registers and receivers and over and above certain allowances to the States for educational purposes, shall be set aside as the reclamation fund. Subsequent legislation providing for the platting of town sites and the sale of lots therein has operated to increase the proceeds from the sales of public lands. Other legislation has provided that receipts from the sale or lease of property purchased with the fund shall be returned to the fund. Finally, the cost of construction of the irrigation works must be repaid in ten installments, so that within ten years after the completion of the projects now in hand the cost of these projects will be returned.

The amount of the future increments to the fund from the sale of public lands is necessarily a matter of conjecture and is dependent on conditions affecting the disposition of the public domain in the West. The lands available for settlement have largely been taken up, but from time to time additional lands have been opened to entry, and as these lands are often of exceptional value, they are eagerly sought for.

As the construction of a large irrigation project is a matter of years, it is necessary to make some forecast of the probable receipts. While contracts and other liabilities can not legally be incurred beyond the present amount in the Treasury, works must be planned and portions of the contract let as the funds are available, with a view to taking up the other parts of the work at such times when their construction is feasible and the money is in hand. In order to make intelligent predictions of the probable accretions to the fund, figures showing the amounts derived from sales of public lands during past years have been studied very carefully. The following table has been compiled from the report of the Commissioner of the General Land Office for 1903, page 209.

Cash receipts, consisting of sales, fees, and commissions, from disposal of public lands in reclamation States from July 1, 1891, to June 30, 1900.

State.	1892.	1893.	1894.	1895.	1896.
Arizona	$78,571.24	$90,992.79	$43,427.59	$27,459.30	$36,043.14
California	618,230.68	466,999.17	224,450.33	128,004.33	156,337.05
Colorado	305,018.17	369,317.25	161,895.89	134,290.14	156,535.07
Idaho	140,468.11	162,230.51	87,984.25	84,126.69	97,976.05
Kansas	181,721.34	191,800.61	59,325.62	31,846.92	20,318.50
Montana	299,398.30	306,190 30	153,133 63	154,171.72	186,314.74
Nebraska	281,633.74	257,884.22	114,720.51	75,016.80	52,977.42
Nevada	6,278.48	4,153.30	1,761.76	5,019.75	27,147.60
New Mexico	99,574.81	107,022.42	52,569.67	31,852.10	28,123.44
North Dakota	176,914.69	188,774.45	84,476.98	74,612.19	93,428.17
Oklahoma	212,303.34	172,240.10	449,514.26	298,667.22	225,241.66
Oregon	409,016.72	422,600.06	133,315.97	74,675.56	88,350.62
South Dakota	216,924 04	252,550.43	128,101.50	111,837.03	67,426.43
Utah	106,986.07	94,657.11	62,556.25	43,466.68	68,347.20
Washington	496,422.16	453,058.53	256,099.90	115,487.70	89,869.71
Wyoming	117,700.99	90,640.40	56,954.43	54,805.48	55,725.06
Total	13,747,162.88	3,631,111.65	2,072,288.54	1,445,339.61	1,450,161.86
Net amount that would have been available for reclamation fund[a]	3,185,000.00	3,085,000.00	1,760,000.00	1,230,000.00	1,230,000.00

[a] Five per cent is deducted from the total receipts for educational purposes and 10 per cent for allowances to registers and receivers.

Cash receipts, consisting of sales, fees, and commissions, from disposal of public lands in reclamation States from July 1, 1891, to June 30, 1900—Continued.

State.	1897.	1898.	1899.	1900.
Arizona	$29,306.08	$27,852.88	$33,370.88	$39,983.16
California	137,728.05	104,773.80	144,493.38	174,164.71
Colorado	135,897.34	164,535.07	140,496.51	229,635.58
Idaho	60,368.99	75,865.63	113,698.51	156,623.61
Kansas	18,774.37	22,368.09	24,280.55	30,929.80
Montana	137,937.00	227,473.83	240,020.00	417,892.20
Nebraska	51,419.60	33,373.68	88,934.96	121,923.97
Nevada	11,300.75	4,112.15	2,286.32	10,021.77
New Mexico	45,138.19	27,739.40	41,363.85	61,740.07
North Dakota	89,217.11	167,512.15	180,466.88	357,435.63
Oklahoma	137,474.53	422,327.32	650,393.52	678,639.38
Oregon	148,177.09	77,370.41	148,389.97	326,793.63
South Dakota	75,265.33	109,030.03	154,537.07	193,042.20
Utah	58,462.93	69,987.10	63,241.12	77,077.06
Washington	90,950.37	114,252.05	130,426.51	228,756.61
Wyoming	49,755.57	94,675.12	93,268.85	199,604.96
Total	1,277,173.28	1,773,248.71	2,249,668.88	3,304,264.34
Net amount that would have been available for reclamation fund [a]	1,085,000.00	1,505,000.00	1,910,000.00	2,810,000.00

[a] Five per cent is deducted from the total receipts for educational purposes and 10 per cent for allowances to registers and receivers.

After the passage of the reclamation act the receipts from the sales of public lands largely increased, the maximum being reached in 1903, since which there has been a gradual falling off until 1906, when the receipts were practically the same as 1905. The following tables show the amounts by States for the fiscal years 1901 to 1906, and the restricted and unrestricted portions of the fund for each State.

Amounts covered into the reclamation fund, July 1, 1900, to June 30, 1906, by States.

State.	1901.	1902.	1903.	1904.	1905.	1906.
Arizona	$42,586.16	$39,187.35	$48,360.20	$63,266.02	$50,368.46	$54,559.06
California	205,030.40	298,240.36	839,221.40	482,077.16	498,488.37	239,320.01
Colorado	254,889.88	374,105.13	549,812.89	472,379.85	318,546.14	534,068.16
Idaho	206,645.36	300,803.27	650,331.95	493,697.20	383,221.74	315,175.56
Kansas	20,188.78	28,946.94	27,836.50	32,478.56	30,423.91	75,370.50
Montana	367,342.31	405,035.49	558,071.49	466,708.41	349,529.75	486,637.10
Nebraska	102,963.24	132,234.94	138,728.70	118,786.59	179,136.10	74,704.24
Nevada	9,183.47	14,230.61	14,136.76	16,210.58	11,167.70	35,843.13
New Mexico	75,203.06	72,034.60	154,265.49	86,602.58	133,243.57	202,015.97
North Dakota	449,474.96	778,021.35	1,244,916.47	1,160,386.68	807,792.48	933,012.96
Oklahoma	370,464.93	638,330.44	864,766.83	763,511.39	490,629.78	514,325.73
Oregon	364,988.62	545,972.44	1,896,970.68	1,350,651.21	610,797.39	491,069.48
South Dakota	113,274.20	194,288.17	248,696.14	249,225.28	217,688.34	279,300.55
Utah	98,416.00	48,408.38	88,872.38	48,716.82	77,662.81	114,595.02
Washington	257,180.95	536,907.82	1,109,299.54	696,271.34	451,773.36	489,958.56
Wyoming	206,989.59	178,773.24	279,709.18	325,283.92	195,045.49	326,380.47
Total	3,144,821.91	4,585,520.53	8,713,996.60	6,826,253.59	4,805,515.39	5,166,336.50

Total receipts, 1901–1906, and restricted and unrestricted portions of the reclamation fund, by States.

State.	Total, 1901–1906.	Restricted portion, 51 per cent.	Unrestricted portion, 49 per cent.
Arizona	$298,327.25	$152,146.90	$146,180.35
California	2,562,377.70	1,306,812.63	1,255,565.07
Colorado	2,503,802.05	1,276,939.04	1,246,863.01
Idaho	2,349,875.08	1,198,436.29	1,151,438.79
Kansas	215,245.19	109,775.05	105,470.14
Montana	2,633,324.55	1,342,995.52	1,290,329.03
Nebraska	746,553.81	380,742.44	365,811.37
Nevada	100,772.25	51,393.85	49,378.40
New Mexico	723,365.27	368,916.29	354,448.98
North Dakota	5,373,604.90	2,740,538.50	2,633,066.40
Oklahoma	3,642,029.10	1,857,434.84	1,784,594.26
Oregon	5,260,449.82	2,682,829.41	2,577,620.41
South Dakota	1,302,472.68	664,261.06	638,211.62
Utah	476,671.41	243,102.42	233,568.99
Washington	3,541,391.57	1,806,109.70	1,735,281.87
Wyoming	1,512,181.89	771,212.76	740,969.13

From time to time estimates of the future proceeds from the sales of lands have been made by the Commissioner of the General Land Office, and the most recent estimates are that the amount available from such sales will be $4,275,969.04 for the fiscal year ending June 30, 1907, and $4,062,170.59 for 1908. Should this forecast of the future increments to the fund be verified, the gross amount covered into the fund to June 30, 1908, will have amounted to $41,580,584.15.

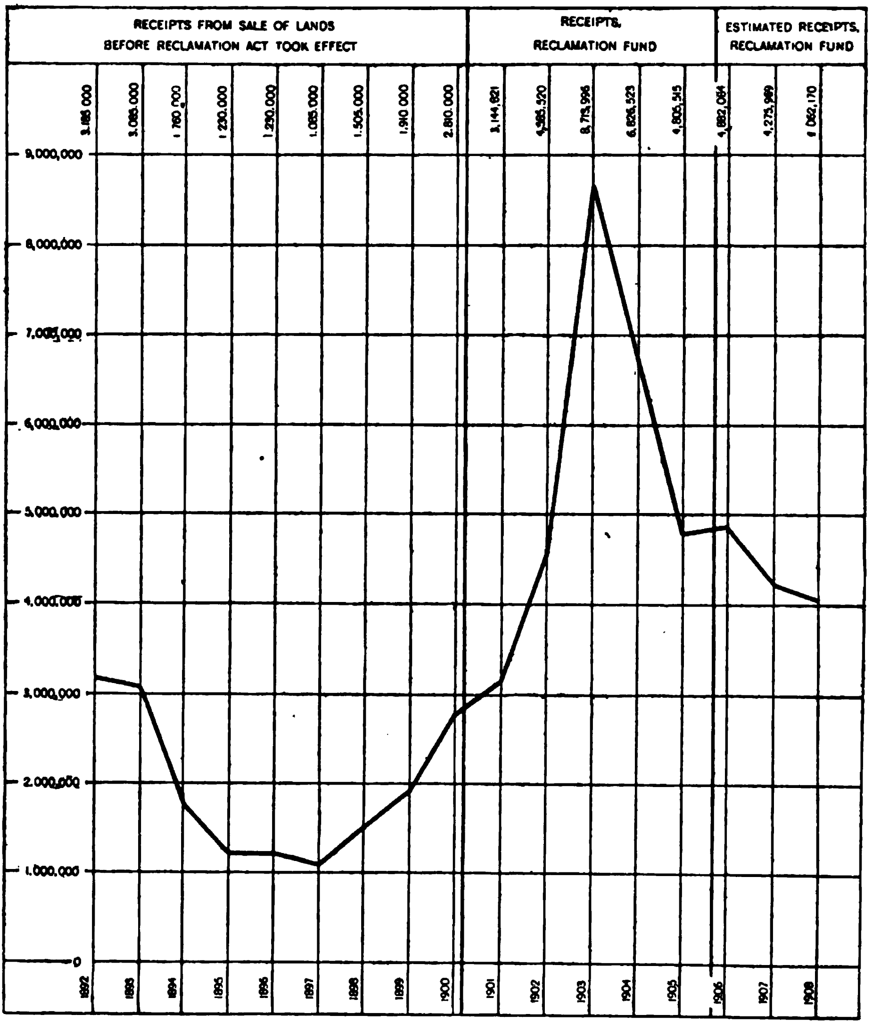

FIG. 1.—Diagram showing the proceeds from sales of public lands in the reclamation States, 1891 to 1908.[a]

Fig. 1 represents graphically the following data: The receipts from sale of public lands from July 1, 1891, to June 30, 1900, the nine years immediately preceding the date when these receipts were turned into the reclamation fund; the amount covered into the fund from July 1, 1900, to June 30, 1905; and the probable receipts from July 1, 1905, to June 30, 1908, as estimated by the General Land Office.

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[a] The receipts for 1906, as given on page 41, are slightly greater than the amount shown in this diagram; this is due to the fact that the final figures for 1906 were received after the diagram had been prepared.

ALLOTMENTS.

As the examination and survey of projects has developed their feasibility—from both engineering and financial points of view—allotments have been made for the required work. The following list gives the date and amount of all allotments and authorizations made up to July 12, 1906.

Chronological list of authorizations and allotments.

1.	Mar. 14, 1903, approving in general terms: Sweetwater project, Wyoming (see North Platte, Nebraska-Wyoming). Milk River project, Montana. Truckee project, Nevada (see Truckee-Carson). Gunnison project, Colorado (see Uncompahgre Valley). Salt River project, Arizona. No specific allotments made.	
2.	Nov. 10, 1903, approving Hondo project, New Mexico, estimated cost..	$240,000
3.	Feb. 10, 1904, approving Cody project, Wyoming (see Shoshone), and setting aside	2,250,000
4.	Apr. 23, 1904, approving Minidoka project, Idaho, and setting aside....	2,600,000
5.	May 3, 1904, Sweetwater project, Nebraska-Wyoming, and substituting Pathfinder (see North Platte), and setting aside	1,000,000
6.	May 10, 1904, approving Belle Fourche project, South Dakota, and setting aside	2,100,000
7.	May 10, 1904, approving Fort Buford project, North Dakota-Montana (see Lower Yellowstone), and setting aside	1,200,000
8.	May 10, 1904, approving Yuma project, California-Arizona, and setting aside	3,000,000
9.	May 11, 1904, approving Malheur project, Oregon, and setting aside....	2,000,000
10.	June 7, 1904, approving Uncompahgre Valley project, Colorado, and setting aside	2,500,000
11.	Nov. 14, 1904, preliminary approval of Palouse project, Washington.	
12.	Nov. 18, 1904, approving pumping projects in North Dakota (see Buford-Trenton, Williston, and Nesson) and setting aside	550,000
13.	Dec. 22, 1904, approving acqusition of North Platte Canal on North Platte project, Nebraska-Wyoming.	
14.	Mar. 25, 1905, approving tentatively the St. Mary Lakes Reservoir, Montana (see Milk River), and setting aside	1,000,000
15.	Mar. 27, 1905, approving Payette-Boise project, Idaho, and setting aside	1,300,000
16.	Apr. 18, 1905, approving Huntley project, Montana, and setting aside.	900,000
17.	May 15, 1905, approving Klamath project, Oregon-California, at an estimated cost of $4,400,000, and setting aside	1,000,000
18.	Sept. 16, 1905, approving Garden City project, Kansas, and setting aside	258,000
19.	Sept. 18, 1905, rescinding approval of Garden City project, Kansas.	
20.	Oct. 5, 1905, canceling letter of September 18, 1905, rescinding approval of Garden City project, Kansas.	
21.	Nov. 28, 1905, approving Carlsbad project, New Mexico, and setting aside	600,000
22.	Dec. 2, 1905, approving Okanogan project, Washington, and setting aside	500,000
23.	Dec. 2, 1905, approving Leasburg diversion, Rio Grande project, New Mexico, and setting aside	200,000
24.	Dec. 4, 1905, approving Umatilla project, Oregon, and setting aside...	1,000,000
25.	Dec. 12, 1905, approving Sunnyside project, Washington, and setting aside	750,000
26.	Dec. 12, 1905, approving Tieton project, Washington, and setting aside.	1,000,000
27.	Dec. 15, 1905, approving Strawberry Valley project, Utah, and setting aside	1,250,000

28. Jan. 8, 1906:
    - Approving estimate for Salt River project, Arizona $3,850,000
    - Approving estimate for Truckee-Carson project, Nevada 3,000,000
    - Approving increase of estimate for Lower Yellowstone project, North Dakota-Montana 700,000
    - Approving increase of estimate for Garden City project, Kansas 2,000
    - Approving increase of estimate for North Platte project, Nebraska-Wyoming 2,330,000
    - Approving reduction in allotment to Malheur project, Oregon, on account amount set aside for Umatilla project, Oregon, Dec. 4, 1905 1,000,000
    - Approving reduction in allotment to Minidoka project, Idaho, on account amount set aside for Payette-Boise project, Idaho, Mar. 27, 1905 1,300,000
29. Jan. 13, 1906, approving Arizona dam, Salt River project, Arizona, and setting aside 375,000
30. Jan. 15, 1906, approving St. Mary project, Montana (see Milk River), and authorizing construction.
31. Jan. 23, 1906, setting aside for Buford-Trenton, Williston, and Nesson projects, North Dakota 450,000
32. Feb. 26, 1906, approving Sun River project, Montana, work of construction to be deferred.
33. Mar. 7, 1906, approving purchase of Arizona canal, Salt River project, Arizona, and setting aside 314,161
34. Mar. 19, 1906, approving construction of Sun River project, Montana, and setting aside 500,000
35. Mar. 27, 1906, approving Tieton and Sunnyside projects, Washington.
36. June 15, 1906:
    - Approving that allotment for Sunnyside project, Washington, be increased by 350,000
    - Approving that allotment for Tieton project, Washington, be increased by 250,000
37. June 16, 1906, approving Yakima Indian Reservation project, Washington (see Wapato), and setting aside 100,000
38. July 12, 1906:
    - Approving that allotment for Hondo project, New Mexico, be increased by 96,000
    - Approving that allotment for Minidoka project, Idaho, be increased by 250,000
    - Approving that allotment for Truckee-Carson project be increased by 700,000
    - Approving that allotment for Payette-Boise project, Idaho, be increased by 190,000
    - Approving that allotment for Lower Yellowstone project, North Dakota-Montana, be increased by 800,000
    - Approving that allotment for Klamath project, Oregon-California, be increased by 1,000,000
    - Approving reduction in allotment to Malheur project, Oregon, on account of amount transferred to Klamath project, Oregon 1,000,000

In the following table the various allotments are arranged by States and projects, and there is shown the total amount authorized for each project.

Allotments arranged by projects.

State.	Project.	Authority No.	Date.	Allotment.	Total.
Arizona	Salt River	1	Mar. 14, 1903		
		28	Jan. 8, 1906	$3,850,000	
		29	Jan. 13, 1906	375,000	
		32	Mar. 7, 1906	314,161	
					$4,539,161
California-Arizona	Yuma	8	May 10, 1904		3,000,000
Colorado	Uncompahgre	1	Mar. 14, 1903		
		10	June 7, 1904		2,500,000
Idaho	Minidoka	4	Apr. 23, 1904	2,600,000	
		28	Jan. 8, 1906	[a]1,300,000	
		38	July 12, 1906	250,000	
					1,550,000

[a] Reduction.

Allotments arranged by projects—Continued.

State.	Project.	Authority No.	Date.	Allotment.	Total.
Idaho	Payette-Boise	15	Mar. 27, 1905	$1,300,000	
		38	July 12, 1906	190,000	$1,490,000
Kansas	Garden City	18	Sept. 16, 1905	258,000	
		28	Jan. 8, 1906	2,000	260,000
Montana	Milk River	1	Mar. 14, 1903		
		14	Mar. 25, 1905		1,000,000
		30	Jan. 15, 1906		
	Huntley	16	Apr. 18, 1905		900,000
	Sun River	32	Feb. 26, 1906		
		34	Mar. 19, 1906		500,000
Nebraska-Wyoming	North Platte	1	Mar. 14, 1903		
		5	May 3, 1904	1,000,000	
		13	Dec. 22, 1904		
		28	Jan. 8, 1906	2,330,000	3,330,000
Nevada	Truckee-Carson	1	Mar. 14, 1903		
		28	Jan. 8, 1906	3,000,000	
		38	July 12, 1906	700,000	3,700,000
New Mexico	Hondo	2	Nov. 10, 1903	240,000	
		38	July 12, 1906	96,000	336,000
	Carlsbad	21	Nov. 28, 1905		600,000
	Rio Grande-Leasburg	23	Dec. 2, 1905		200,000
North Dakota-Montana	Lower Yellowstone	7	May 10, 1904	1,200,000	
		28	Jan. 8, 1906	700,000	
		38	July 12, 1906	800,000	2,700,000
North Dakota	Buford-Trenton Williston Nesson	12	Nov. 18, 1904	550,000	
		31	Jan. 23, 1906	450,000	1,000,000
Oklahoma					
Oregon-California	Klamath	17	May 15, 1905	1,000,000	
		38	July 12, 1906	1,000,000	2,000,000
Oregon	Umatilla	24	Dec. 4, 1905		1,000,000
	Malheur	9	May 11, 1904	2,000,000	
		28	Jan. 8, 1906	[a]1,000,000	
		38	July 12, 1906	[a]1,000,000	
South Dakota	Belle Fourche	6	May 10, 1904		2,100,000
Texas					
Utah	Strawberry Valley	27	Dec. 15, 1905		1,250,000
Washington	Okanogan	22	Dec. 2, 1905		500,000
	Tieton	26	Dec. 12, 1905	1,000,000	
		35	Mar. 27, 1906		
		36	June 15, 1906	250,000	1,250,000
	Sunnyside	25	Dec. 12, 1905	750,000	
		35	Mar. 27, 1906		
		36	June 15, 1906	350,000	1,100,000
	Wapato (Indian reservation).	37	June 16, 1906		100,000
Wyoming	Shoshone	3	Feb. 10, 1904		2,250,000
	Total allotments				39,155,161

[a] Reduction.

EXPENDITURES.

In addition to the primary authorized projects for which definite allotments have been made, preliminary examination has been made of a large number of other or secondary projects, and a considerable study given to them with a view to developing such data as to make it possible to select the best of such projects for construction when those now in hand have been brought to completion. Expenditures to June 30, 1906, on the primary projects, had amounted to $12,152,702.84; and on secondary projects to $621,456.84. The following tables are largely self-explanatory. The first is a controlling statement of the general accounts. The supplemental or supporting statements show the expenditures by fiscal quarters and years, the repayments or drawbacks upon expenditures, the net expenditures by projects and town sites, and the balances on hand. The total expenditures by projects are further analyzed under each project report, there being for each project a table showing a distribution of expenses according to purpose and character, and for each primary or authorized project a table showing an analysis according to the physical features of the project.

TABLE 1.—*Controlling statement of the accounts of the reclamation fund (32 Stat., 388), June 30, 1906.*

			Dr.	Cr.
By receipts for 1901, appropriation warrant No. 5, October 15, 1902				$3,144,821.91
By receipts for 1902, appropriation warrant No. 16, June 3, 1903				4,585,520.53
By receipts for 1903, appropriation warrant No. 13, February 1, 1904				8,713,996.60
By receipts for 1904, appropriation warrant No. 6, January 5, 1905				6,826,253.59
By receipts for 1905, appropriation warrant No. 10, January 22, 1906				4,805,515.39
To total expenditures, as per table 2		$12,857,427.00		
Less reductions credited as per table 3	$59,628.94			
Less repayments credited as per table 4	19,525.46			
		79,154.40		
To net expenditures on reclamation projects, as per table 5			$12,774,159.68	
To net expenditures on town sites, as per table 6			4,112.92	
To balances with disbursing officers, as per table 7			386,075.37	
To balance in U. S. Treasury		$15,057,085.97		
Less approved claims charged to projects but not yet settled in Treasury Department		145,325.92		
			14,911,760.05	
			28,076,108.02	28,076,108.02

TABLE 2.—*Amounts of the vouchers and claims approved for payment from the reclamation fund.*

Quarter ending—	
September 30, 1902	$20,700.24
December 31, 1902	79,693.76
March 31, 1903	83,065.15
June 30, 1903	102,981.04
Fiscal year 1903	286,440.21
September 30, 1903	224,595.29
December 31, 1903	248,695.82
March 31, 1904	340,226.03
June 30, 1904	647,787.87
Fiscal year 1904	1,461,305.01
September 30, 1904	761,701.09
December 31, 1904	973,067.63
March 31, 1905	834,377.88
June 30, 1905	1,184,178.38
Fiscal year 1905	3,753,324.98
September 30, 1905	1,420,091.73
December 31, 1905	1,806,443.49
March 31, 1906	1,684,983.37
June 30, 1906	2,444,838.21
Fiscal year 1906	7,356,356.80
Total expenditures to June 30, 1906	12,857,427.00

TABLE 3.—*Repayments to Reclamation Fund by disbursing officers.*

Items acknowledged by disbursing officers and entered in accounts current:		
Quarter ending—		
March 31, 1903	$202.21	
June 30, 1903	40.16	
September 30, 1903	74.31	
December 31, 1903	11.98	
March 31, 1904	104.31	
June 30, 1904	191.25	
September 30, 1904	525.05	
December 31, 1904	87.21	
March 31, 1905	97.90	
June 30, 1905	468.75	
September 30, 1905	69.09	
December 31, 1905	215.98	
March 31, 1906	220.52	
June 30, 1906	61.57	
		$2,370.29
Amount of claims withdrawn from settlement and reduction of claims by auditor, July, 1902, to June 30, 1906[a]		57,258.65
Total reduction of expenditures		59.628.94

TABLE 4.—*Repayments to Reclamation Fund, June 30, 1906.*

Projects credited.	Sales of property.	Leases of land and buildings.	Refunds on freights paid by Reclamation Service.	Refunds on freights paid by contractors.	Forfeitures by defaulting bidders.
Arizona: Salt River	$223.08		$247.75		
California-Arizona: Yuma	215.15		2.65		
Colorado:					
Uncompahgre	418.13		4,057.23		
Colorado River storage	150.00				
Idaho: Minidoka	46.00		1,895.73		
Montana:					
Huntley					$4,000.00
Milk River	44.50				
Nebraska-Wyoming: North Platte	18.25				5,000.00
Nevada: Truckee-Carson			5.60	$458.51	
New Mexico:					
La Plata	1,700.55				
Urton Lake	125.25				
North Dakota-Montana: Lower Yellowstone			38.31		
Oregon: Umatilla	33.55				
Utah: Strawberry Valley	160.50				
Washington: Palouse	92.65				
Wyoming: Shoshone			568.02		
Washington Office: General administration	24.05				
Total	3,251.66		6,815.29	458.51	9,000.00
Total					19,525.46

TABLE 5.—*Net expenditures on reclamation projects, June 30, 1906.*

Arizona:	
Salt River project	$2,678,370.77
Proposed San Carlos project	22,126.61
Proposed San Pedros project	2,341.62
Proposed Little Colorado project	5,316.81
California:	
Proposed Sacramento Valley project	36,704.06
Proposed Owens Valley project	25,970.38
Proposed San Joaquin project	3,524.17

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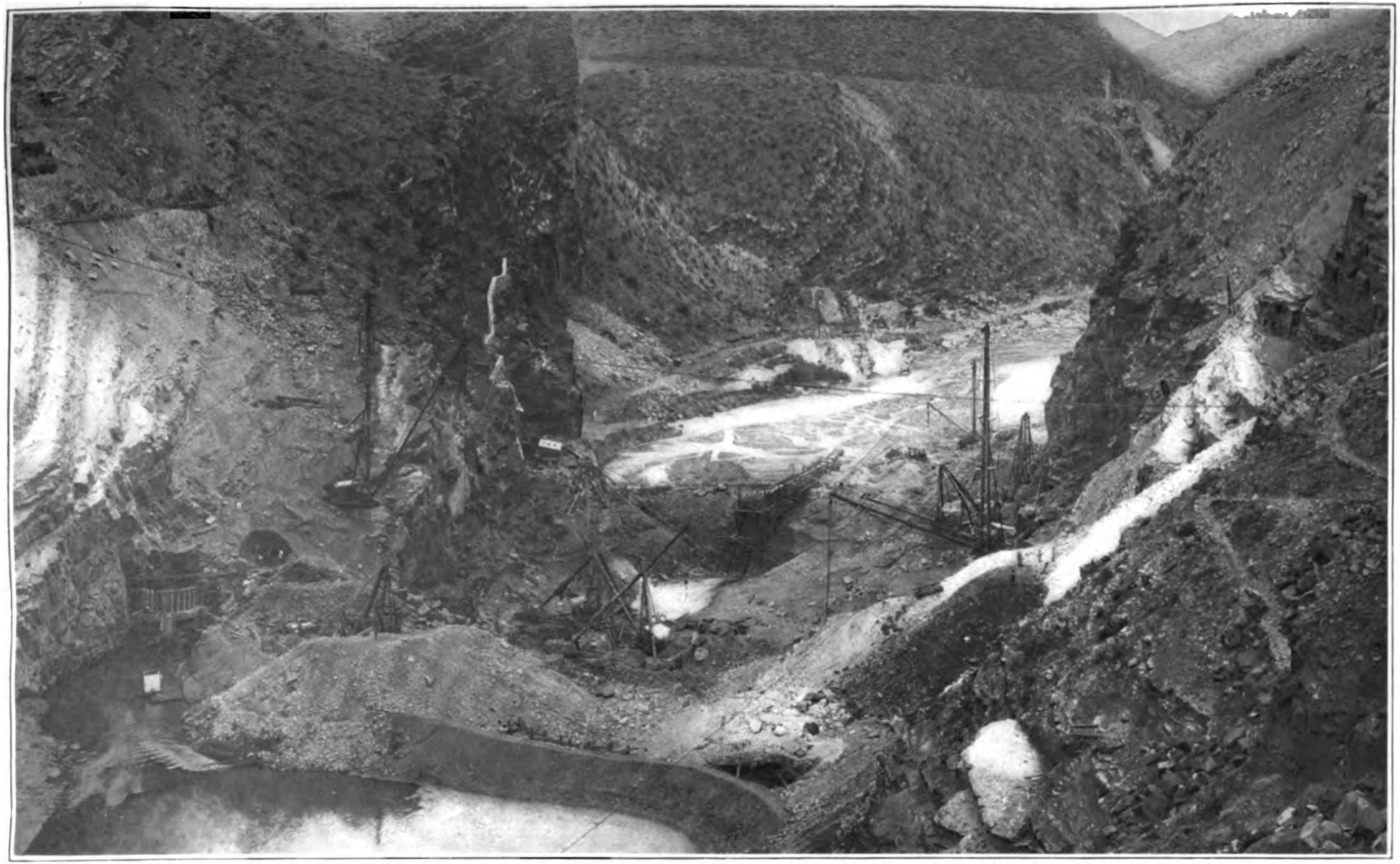
[a] These reductions represent (1) repayments made by the disbursing officers on their own initiative because of errors detected by them subsequent to payment; (2) reductions by the auditor after the administrative examination and approval of accounts.

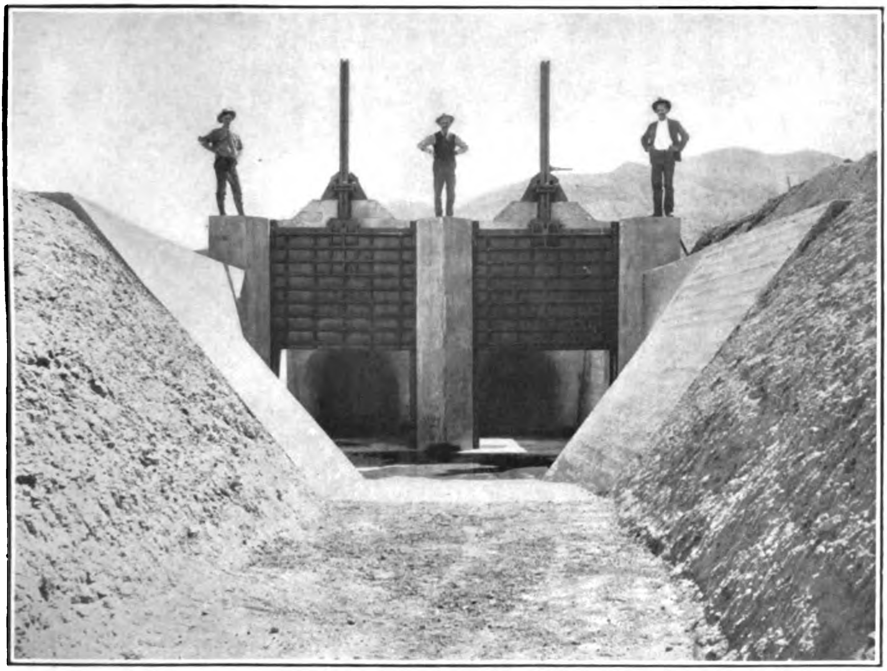
California-Arizona: Yuma project	$653,821.89
Colorado:	
Uncompahgre Valley project	1,318,049.15
Proposed Grand River project	8,712.20
Proposed White River project	3,855.79
Colorado, Utah, Nevada, California, Arizona: Colorado River storage	17,913.09
Idaho:	
Minidoka project	961,806.64
Payette-Boise project	177,614.16
Proposed Dubois project	19,489.25
Kansas: Garden City project	11,862.84
Montana:	
Milk River project	152,999.58
Huntley project	123,181.20
Sun River project	60,147.04
Proposed Crow Reservation project	21,032.58
Proposed Madison River project	10,546.96
Proposed Lake Basin project	7,015.46
Proposed Clarke Fork project	5,795.06
Nebraska: South Platte underflow investigation	2,847.17
Nebraska-Wyoming: North Platte project	907,760.26
Nevada:	
Truckee-Carson project	3,112,436.15
Proposed Walker River project	12,220.29
New Mexico:	
Hondo project	303,687.47
Carlsbad project	216,867.39
Proposed Urton Lake project	17,762.24
Proposed Las Vegas project	4,233.30
Proposed La Plata project	27,697.03
New Mexico-Texas:	
Rio Grande project (Leasburg diversion)	6,833.48
Rio Grande project	48,404.15
North Dakota-Montana: Lower Yellowstone project	262,458.67
North Dakota:	
Buford-Trenton project	17,798.08
Williston project	30,663.36
Nesson project	17,781.77
Proposed Bismarck project	14,208.67
Proposed Little Missouri project	5,889.65
Oklahoma	45,873.31
Oregon:	
Umatilla project	54,841.49
Proposed Malheur project	71,067.22
Proposed Central Oregon projects	22,629.23
Oregon-California: Klamath project	281,226.95
South Dakota: Belle Fourche project	301,115.75
Utah:	
Strawberry Valley project	45,409.35
Proposed Utah Lake project	34,040.05
Proposed Bear Lake project	18,718.34
Washington:	
Okanogan project	33,831.25
Yakima district—	
Tieton project	26,167.65
Sunnyside project	21,111.42
Wapato project	919.32
Proposed Kittitas project	6,566.54
Proposed Benton project	10,900.45
Proposed Palouse project	75,834.74
Proposed Priest Rapids project	6,191.83
Wyoming:	
Shoshone project	347,314.33
Proposed Lake De Smet project	8,985.68
General administration: Inventory	23,668.34
Total	12,774,159.68



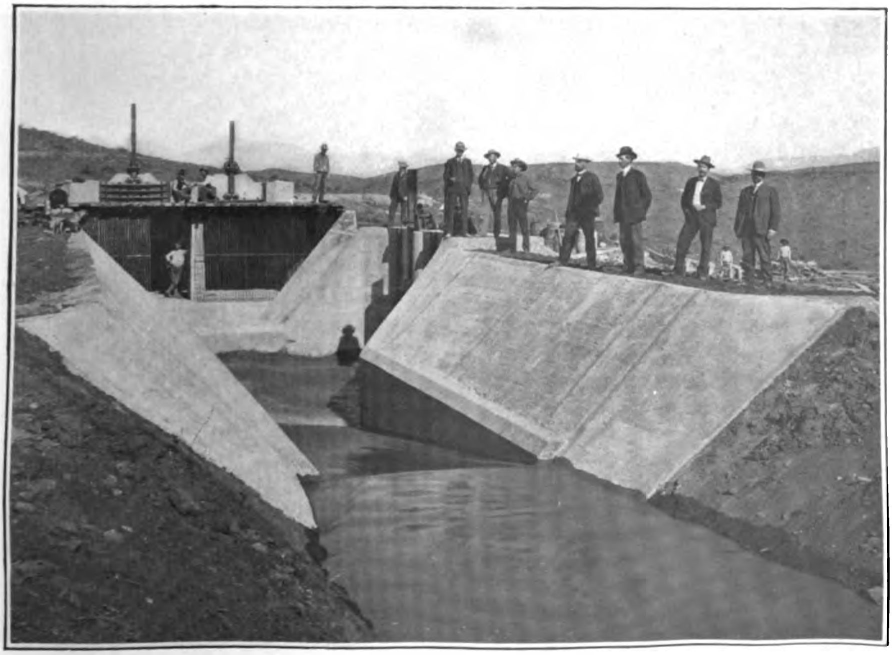
CONSTRUCTION WORK ON THE ROOSEVELT DAM, SALT RIVER PROJECT, ARIZONA, SEPTEMBER 15, 1906.

Salt River being carried around dam site through diverting tunnel, intake of which is seen to left.

M70U



A. OUTLET OF PINTO PRESSURE PIPE ON POWER CANAL, SALT RIVER PROJECT, ARIZONA, FEBRUARY 26, 1906.



B. INTAKE OF COTTONWOOD PRESSURE PIPE ON POWER CANAL, SALT RIVER PROJECT, ARIZONA, MARCH 9, 1906.

TABLE No. 6.—*Net expenditures on town sites to June 30, 1906.*

[Under acts approved April 16, 1906, and June 27, 1906.]

Idaho: Minidoka project: Heyburn, Rupert and Scherer town sites	$4,112.92

TABLE No. 7.—*Balances in the hands of disbursing officers, United States Reclamation Service, June 30, 1906.*

Disbursing clerk, Department of the Interior, George W. Evans	$305.83
Chief disbursing clerk, United States Geological Survey, John D. McChesney	12,850.28
Special disbursing agents, United States Reclamation Service:	
William S. Arthur	11,646.40
Fred. W. Brose	16,672.95
Walter A. Brothers	4,158.82
John J. Buck	40,000.00
Fred L. Cavis	18,554.17
George M. Eba	12,618.76
Harry E. Essley	56,987.23
Joseph C. Gawler	5,287.25
Anton H. Gullickson	25,359.57
Christopher C. Hogue	18,731.62
Frank W. Kirksey	10,895.51
E. George Lind	26,305.65
Edwin D. Newman	5,647.30
Swan T. Olsen	7,520.63
Carlos T. Prall	16,986.73
Henry P. Seidemann	14,511.25
James W. Spencer	19,531.53
John W. Swift	35,338.12
Gordon N. Van Sant	20,937.63
Herbert A. Yates	5,228.14
Total	386,075.37
Balance in the United States Treasury, as shown by the books of the Division of Bookkeeping and Warrants, Treasury Department, at the close of business, June 30, 1906	15,057,085.97

LIABILITIES AND FUTURE EXPENDITURES.

The liabilities against the fund consist principally of the allotments set aside for the construction of the various projects, and of such additional amounts as will be required for those projects for which only a partial allotment has been made. In addition to these general liabilities, specific liabilities are incurred by the negotiation of contracts and the engagement of services. The methods employed for entering into such agreements are hereafter referred to in detail, and the amounts of the contracts for building work are shown in tables accompanying the several project reports. For present purposes it is sufficient to refer to such liabilities only so far as they indicate the amount of money which will be required from time to time to carry on the work at present under way.

Engineers in the field prepare quarterly estimates of the future probable expenditures. These figures are probably nearer the maximum than the minimum amounts that will be required, as they are based upon the assumption that the work will proceed under normal and uniform conditions, and do not take note of the continually recurring obstacles. On the other hand, they are based on present conditions and of necessity can not forecast or take note of possible favorable or unfavorable fluctuations in the market prices of labor and materials. They do, however, present an index to the probable demands on the fund and are therefore of value.

The following table, compiled from the table submitted with the eighteenth (October to December, 1906) quarterly estimates, gives such a forecast for the two years, July 1, 1906, to June 30, 1908:

Estimated expenditures July 1, 1906, to June 30, 1908.

July 1 to September 30, 1906	$3,637,227.52
October 1 to December 31, 1906	6,446,713.91
January 1 to June 30, 1907	9,371,799.44
July 1, 1907 to June 30, 1908	7,801,937.06

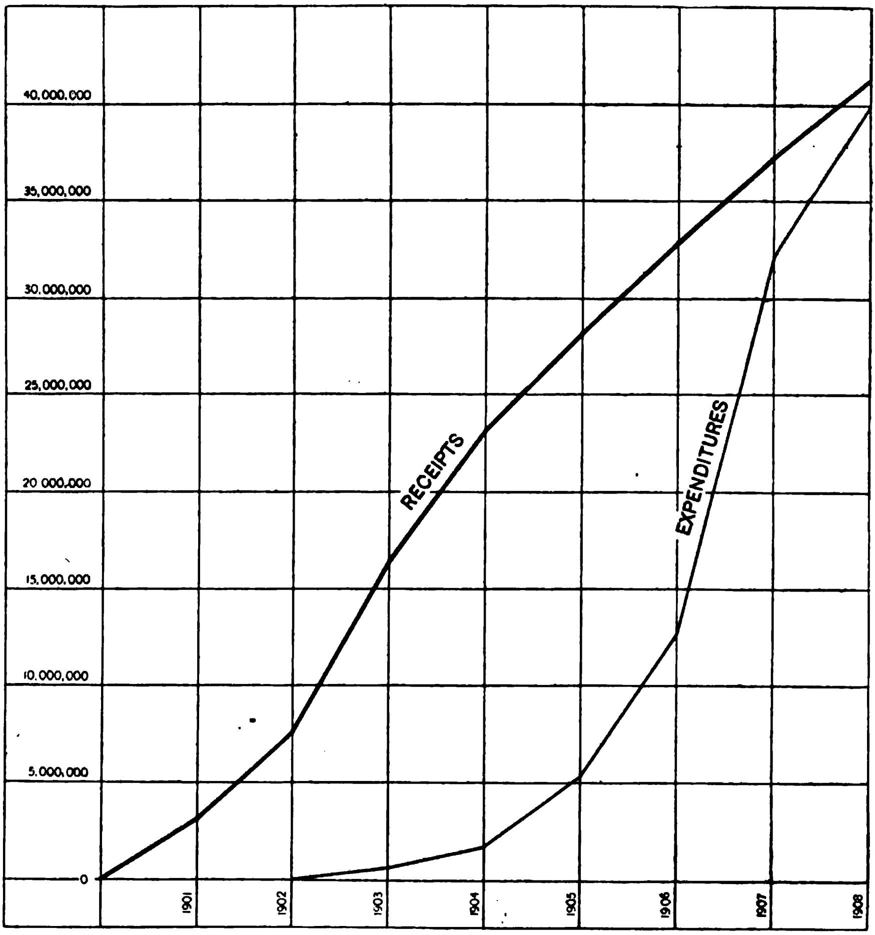


FIG. 2.—Diagram showing the growth of actual and estimated receipts and expenditures 1901 to 1908

These estimates of the actual expenditures to June 30, 1906, and the actual and estimated receipts to June 30, 1908, have been used in the preparation of fig. 2, which shows the growth of receipts and expenditures. The upper curve shows the growth of the funds by additions from year to year, and the lower curve shows the expenditures during the same period.

DETAILED ANALYSIS OF EXPENDITURES.

In the body of this report there appears under each project heading a statement showing a distribution of the total expenditures on such project according to the purpose and character of the expense. For the primary projects whose construction has been authorized, and where active building operations are under way, there is also given an analysis of the total expenditures according to the physical features of the projects.

In the tables showing the estimated cost of the contracts, amount expended, and percentage paid, are listed some fully completed contracts on which the expenditure was greater than the amount of the original estimate. This in most instances is due to the fact that for reasons that could not be foreseen the amount of work has exceeded the estimates; that is, the proposal being at a fixed amount per cubic yard for each kind of material excavated, the estimated cost is based upon the anticipated amount of material and the anticipated classification.

In regard to the classification, great care is taken to determine as far as possible the character of material to be excavated in order to avoid uncertainty in the nature of the work, and as a result to induce contractors to make closer bids. It has been found in many cases that although the material under the surface has been prospected by drilling or test pits at intervals of 100 feet or less along the canal lines, the variations between the points of investigation have often been such as to greatly increase the quantities of the more expensive character of material. Consequently, when these investigations indicated a certain amount of rock, or expensive work, for which a higher bid had been made, the uncovering of the material would show more than had been anticipated, which would result in an increase in the total.

Besides this, when the ground has been uncovered new conditions have been encountered which could not have been foreseen, and it has been necessary to make changes in methods or in structures at a greater expense. This is often the case where water or extremely moist ground has been found in excavations, when a careful examination of the surface did not indicate the probability of unusual conditions.

The amount of material is often increased on account of conditions which it is impossible to foresee. In deep excavations or embankments the slope which the newly uncovered material will take is very often different from that which is indicated by the examination of similar material in its natural state. This would often cause a considerable increase in the amount of material handled.

A number of the contracts have been completed at about the estimated cost or for a considerably less amount. This has been due to the fact that the conditions found as the work progressed were the same as, or more favorable than, those indicated in advance, while in a number of cases the developments of the work afforded opportunity for changes which resulted in a decrease in cost.

FISCAL AUTHORIZATION.

The expenditure of public funds may be made only in pursuance of an appropriation by Congress—except in certain emergencies involving possible loss of life or destruction of public property—and is limited to the amounts stated and to the purposes indicated in the act making the appropriation. Authorization should be distinguished from approval, as authorization usually antedates the incurring of expense (though sometimes in cases of urgency given subsequently by an approval of subordinate action), while approval ordinarily follows the incurring of liabilities to cover the amount of the claim therefor.

The control of the reclamation fund is vested in the Secretary of the Interior, and his authorization, either personal or properly delegated, is necessary for all expenditures. Personal authorization is usually given for matters of a general nature, as (*a*) the authorization of the Reclamation Service to undertake surveys generally; (*b*) the allotments made for primary projects designated for construction; (*c*) the issuance of fiscal regulations governing the Reclamation Service. Delegated authorization is usually given for the details covered by the personal authorization above referred to, and may be by the occasional approval of recommendations covering certain specific matters of urgent importance, as (1) the acquisition of necessary lands or canals, or rights of way; (2) the permission to begin "force account" building where a contractor has failed or proposals are considered exorbitant; (3) the purchase of machinery or materials the necessity for which was not foreseen, etc. Delegated authorization may also be given by the periodic approval of submitted plans and estimates of proposed expenditures.

Quarterly statements are prepared by the supervising engineers outlining the work proposed for the next succeeding quarter. The work will be of varied nature, according to the location and degree of progress theretofore made, but experience has shown that some of the matters to be covered are as follows:

1. The contemplated examination or reconnaissance of new projects or possible extension of existing ones.
2. The boring and drilling necessary to develop information as to the character of the excavation and foundation.
3. The making of location surveys for the necessary canals.
4. The making of topographic surveys of the irrigable lands.
5. The preparation of designs for structures and maps of irrigable lands and canals.
6. The preparation of specifications and advertisements for proposed contracts, etc.
7. The negotiation of agreements with the water users, including investigation of titles and subscriptions.
8. The undertaking of necessary incidental operations, as proposed lumber and cement mills, limekilns, etc.
9. The building (either by contract or force account) of the principal irrigation structures, as canals, ditches, dams, and tunnels, which are described as to necessity and probable cost, including the equipment and materials.
10. The building (either by contract or force account) of necessary incidental structures, as roads, telephone lines, quarters, offices, storehouses, corrals, shops, etc., which are described as to necessity and probable cost, including the equipment and materials required.
11. The purchase of necessary lands, canals, or rights of way.

Submitted with such statements are tables covering the amounts estimated as necessary to accomplish the work outlined. These estimates include:

1. Services of engineers, experts, inspectors, clerks, etc.
2. Wages of foremen, mechanics, laborers, etc.
3. Expenses for subsistence, forage, camp supplies, etc.
4. Expendable supplies, such as fuel, explosives, lubricants, etc.
5. Materials, such as cement, steel, lumber, piles, etc.
6. Equipment, such as machinery, tools, wagons, animals, furniture, etc.
7. Lands, canals, rights of way, etc.
8. Payments on contracts.

The quarterly statements and estimates when received from the field are revised in the administrative offices of the service at Washington, and additional estimates are included covering the general administrative and engineering work of the service.

The occasional special authorizations already referred to are listed under the projects or other headings to which they refer, so as to make the statement the complete and final record of all authorizations.

After the statements and estimates have been approved by the Secretary of the Interior notice of such approval is sent to the engineers, who are thereby authorized to incur the expense necessary for the execution of the work planned. A copy of the approved statement and estimate is transmitted to the Auditor for the Interior Department for use in the subsequent auditing of the accounts submitted under such authorization.

INCURRENCE OF EXPENSE.

Obligations against the reclamation fund are incurred in one of two general ways—by the engagement of personal services or by contracting for or ordering the delivery of supplies or the performance of services other than personal, commonly known as contract or job work.

PERSONAL SERVICE.

For securing the personal services of technical or clerical employees calls are made upon the Civil Service Commission for the certification of eligibles from its registers, and appointments therefrom are made by the Secretary of the Interior. In addition to the classified positions for which certification is asked as above there are a great many positions which require mechanical skill and experience, but for which educational tests are not essential. As the spirit of the civil service law requires that such positions also should be filled entirely upon merit, without regard to the political, religious, or social connections of applicants, the following regulations have been formulated:

The following regulations governing examinations and appointments in the field service of the Reclamation Service have been approved by the Secretary of the Interior and Civil Service Commission and will replace all previous circulars or regulations on this subject:

CLASSIFICATION.

All positions may be considered under one of two headings. First, those requiring an educational test; and, second, those requiring no educational test and known as registered positions. All positions in this Service are classified and subject to examination except those hereafter mentioned under the heading "Unskilled labor.'

(1) *Educational tests.*—Application should be made to the United States Civil Service Commission, Washington, D. C., directly for all information concerning educational tests. A manual of examinations is issued in January and July of each year by the Commission, giving all necessary information concerning future examinations to be held at stated times for various educational positions and showing the qualifications of the persons already eligible from past examinations. In addition, circulars can be had from time to time concerning special examinations. Positions requiring educational tests, if not filled by transfer or promotion or by reinstatement, will be filled by certification from eligible registers of the Commission. Requisitions by engineers in charge for certification for appointment should be sent to the chief engineer. The principal positions requiring an educational test are (*a*) engineering aids; (*b*) assistant engineers; (*c*) engineers; (*d*) draftsmen and computers; (*e*) bookkeepers, clerks, including stenographers, copyists, and typewriters; (*f*) specialists or experts in various lines for which special examinations are held from time to time, such as chemists, electrical engineers, law clerks, physicians, etc.

Certification may be made from the eligibles of the district in which the service is to be rendered.

(2) *Registered positions.*—Applications for registered positions are to be made to local boards of examiners at each of the principal headquarters of the Reclamation Service. Registered positions requiring no educational tests are as follows: (*g*) Superintendents of construction or of grading, corral bosses, etc.; (*h*) inspectors, including inspectors of earthwork, masonry, concrete, etc.; (i) foremen, including master laborers, master workmen, master carpenters; (*j*) survey men, who may perform the duties of transit men, level men, rodmen, chain men. etc.; (*k*) recorders and receivers of material, including property or store clerks, tool keepers, stewards, storekeepers; (*l*) all employees performing special duties, as cement testers, concrete finishers, cranes men, dam and head gate tenders, deputy inspectors, dredge engineers, ditch riders, electrical assistants, engine men, gate tenders, helpers, janitors, line riders, powder men, riggers, skilled laborers, stewards, trackmen, truckmen, watchmen, etc.

UNSKILLED LABOR.

All unskilled laborers are considered to be in the unclassified service, their status being fixed by the fact that they are merely employed as laborers or workmen and their occupation is of the most temporary character. With these are grouped the following: Apprentices in mechanical trades, axemen, bakers, cooks, cook's helpers, boatmen, derrickmen, drillmen, drivers, hostlers, teamsters, waiters.

Boards of examiners.—A board of examiners shall be established at the principal office of each reclamation project, for the purpose of facilitating examination and appointment of noneducational positions, and shall be composed of a secretary, vice-secretary, and one or more additional members, selected by the Commission from names submitted by the chief engineer.

Duties of boards.—The duties of boards of examiners shall be as follows: (*a*) To furnish the Commission, through the chief engineer, with imformation regarding the needs of the Reclamation Service, the conditions of employment, and the qualifications desired of applicants, (*b*) to give out application blanks and circulars of information to applicants, (*c*) to receive applications for positions in which no educational examination is required, (*d*) to grade the papers, (*e*) to establish registers of eligibles, (*f*) to do such other work as the Commission may direct.

Applicants for positions requiring a noneducational test.—Applications for positions requiring a noneducational test, filed with this board of examiners, shall be rated upon the statements made in the formal application, upon the elements of age, physical condition, and experience, in accordance with the following regulations for rating:

Elements.	Weights.
Age	20
Physical condition	20
Experience	60
Total	100

Method of rating examination papers.—Applicants shall be rated on the statements and testimonials in their applications on the elements of age, physical condition, and experience.

Age shall be rated as follows:

Over 25 years and not exceeding 45 years, 100; for each year less than 25 or more than 45, two shall be deducted from 100.

Physical condition shall be rated as follows:

Where there are no apparent physical defects or disqualifications for the practice of the trade or occupation for which the person is examined, a maximum rating of 100 shall be given. Deduction shall be made from 100 in the discretion of the examiner for physical defects or disqualifications according to their gravity.

Experience shall be rated as follows:

A weight of 50 will be given for length of experience and a weight of 50 for character of experience.

For positions requiring apprenticeship, a rating of 30 shall be given to a workman who has acquired the status of journeyman; for each of the following four years a credit of 5 shall be given.

For positions that do not require apprenticeship, a credit of 20 shall be given for one year's experience and an additional credit of 5 for each of the following six years.

The element of character of experience will be rated upon the statements made by the applicant in his application, as corroborated by his vouchers and references. Consideration will be given to the quality and character of the experience shown as well as to the honesty, industry, sobriety, and intelligence of the applicant, which are to be determined by the statements of vouchers, who should be, as far as possible, employers of the applicant. Special consideration shall be given to experience which is continuous and recent.

Where special experience is required for the performance of the duties of a position, which is not sufficiently indicated in the application, local boards shall require the applicant to file such additional written evidence as may be necessary.

The ratings, their products, and the average percentage shall be entered in the proper blanks on the application form, and each mark shall be initialed by the examiner or examiners responsible for the rating.

As the local boards are responsible for the preparation of eligible registers, it is their duty to investigate fully all applicants, in order that no inefficient or improper persons may be made eligible for certification. All applicants, before being declared eligible, shall be required to appear before a member of the board for personal examination, if, in the opinion of the board, this is deemed necessary.

Review by Commission.—All examination papers are subject to review by the Commission, when such review is requested. It is necessary, therefore, that all the facts upon which marking is based by the local civil service board should be made a matter of record. If the rating is affected by personal examination of verbal evidence, the facts should be made of record; if the rating is affected by documentary evidence, such documents should be attached to the examination papers.

Responsibility of board.—Each local board is responsible for the lists prepared by the board, and it is the duty of the members to fully investigate all applications, in order that no inefficient or improper applicants be made eligible for appointment. Certificates and indorsements of unknown persons should not be accepted as complete evidence of capacity or worthiness. Applications will be received, personal examinations made, and rating prepared by any member of the board, the application being forwarded to the board at headquarters for further consideration and final action.

Registers of eligibles.—Separate registers for the various positions shall be established, the names of the eligibles being entered upon the registers in the order of general average, except preference claimants under section 1754 of the Revised Statutes, whose names shall head the registers.

Registering new names.—On the 10th day of each month, and, if necessary, again on the 25th, the board shall prepare new registers of eligibles, the names being entered in the order of the averages attained. New names shall not be entered upon any of the registers on any other day, unless the particular register is exhausted, in which case that register shall be replenished and copies of additional names furnished. Each register should be complete in itself and should contain the name of each person eligible for appointment in the district to which it relates, on the date of issue. The term of eligibility is one year. Eligibles whose terms have expired and those who have been appointed should not appear as eligible. Three copies of the registers shall be prepared. One copy shall be transmitted by the local boards to the chief engineer and one copy to the Commission monthly. Each register shall contain all the eligibles and shall show in each case the reason for the removal of any names during the month, whether by appointment, declination, by reason of three certifications, or by expiration of period of eligibility.

Preference for appointment, section 1754, R. S.—This section gives preference to persons honorably discharged from the military or naval service by reason of disability resulting from wounds or sickness incurred in the line of duty, provided they are found to possess the business capacity necessary for the proper discharge of the duties of such offices. It is improbable that many such cases will occur, and the Commission will decide all such claims and inform the local boards of its decisions.

When an applicant states that he was discharged from the military or naval service on account of disability incurred in line of duty, the local board should report to the Commission the name, regiment, and company, or vessel, and dates of enlistment and discharge.

Eligibility for appointment in other districts.—An eligible in any district may have his name entered upon the proper register of another district for a period not to exceed one year from the date of his report of eligibility to the secretary of the local board with a written request for such action.

Appointments.—Upon the occurrence of a vacancy in a registered position a selection from the register of the local board will be made by the responsible engineer in charge. In making selections from the register prepared by the local civil service boards due regard will be given to the particular qualifications required to fill properly the vacant position, and one of the highest three possessing such qualifications must be selected. An eligible whose name has been three times considered may be dropped from the register, but it is necessary in order to drop a name that it shall have been considered in connection with three different vacancies. Notice of selection should be forwarded at once to the chief engineer and should specify the terms of employment, the amount to be paid, deductions to be made, if any, for subsistence, hospital dues, and other items. If the compensation includes subsistence in addition to cash payments, this matter must be fully covered.

Local boards of examiners will be constituted by the Commission at the following points:

Arizona: Phoenix, for Salt River project.
California-Arizona: Yuma, for Yuma project.
California-Oregon: Klamath Falls, for Klamath project.
Colorado: Montrose, for Uncompahgre project.
Idaho: Boise, for Minidoka and Payette-Boise projects.
Kansas: Garden City, for Garden City project.
Montana: Huntley, for Lower Yellowstone project, Sun River project, Huntley project, St. Mary project, Williston, N. Dak., project.
Nebraska: Mitchell, for the Interstate Canal.
Nevada: Hazen, including Truckee-Carson project.
New Mexico: Carlsbad, for Carlsbad and Hondo projects, Oklahoma project, and Rio Grande project.
Oregon: Portland, for Umatilla project, Oregon; Yakima project, Washington; and Okanogan project, Washington.
South Dakota: Belle Fourche, for the Belle Fourche project.
Utah: Salt Lake City, for Strawberry Valley project.
Wyoming: Cody, for Shoshone project.

PROMOTION AND OTHER CHANGES IN STATUS.

(*a*) Any classified employee, after one year's satisfactory service, may become eligible for any position for which an educational examination is necessary, provided he secures the requisite percentage in the appropriate examination, held under the direction of the Commission.

(*b*) A noneducational employee serving in any capacity may be temporarily assigned to duty in any other noneducational position the duties of which are similar and for which no additional special qualifications are required. Continuation for a longer period than thirty days in such new position must be contingent upon registration by the local board in the new position.

(*c*) A classified employee in any recognized mechanical trade shall not be assigned to duty in a different mechanical trade without examination. Such examination shall be similar to that required for original registration in the grade to which the assignment is to be made.

TEMPORARY EMPLOYMENT.

In urgent cases, when time does not permit the appointment through certification from the Commission, a vacancy in any educational position may be filled by the responsible engineer in charge by temporary appointment of any one possessing the necessary qualifications. Such temporary appointment shall not continue for a greater length of time than may be necessary to secure certification and selection of a suitable person from the register; provided, however, that in cases where a competent person will not accept immediate employment continuing for a minimum time, then the employment may be for such reasonable minimum time as will secure the necessary services.

The engineer in charge shall take steps to obtain proper certification without unnecessary delay. A report of the appointment and request for certification will be immediately made to the chief engineer, and the report and request, if approved, will be forwarded through the Department to the Commission.

Engineers are authorized, after having reported a temporary appointment and requested certification, to continue the temporary employment, if necessary, until action is taken on the request or until special instructions are received.

Temporary appointment may be made to fill a vacancy in a registered position when there is no register of eligibles and may continue until a register of eligibles is established; but such temporary appointment shall not continue longer than thirty days. Persons temporarily employed in such registered positions may become eligible for regular appointment by being entered upon the register. Such temporary appointments should be avoided and should continue for as short a time as conditions permit. The temporary employee should be instructed to present himself as soon as possible before the local board, with a view to examination, registration, and becoming eligible for regular employment.

FORMS TO BE USED.

For the present, or until further instructions are given, Form 9-563 and Form 9-569 are to be used. These are modeled upon the civil service Form 1086, Application for Noneducational Position in the U. S. Engineer Department at Large. Experience has shown that better results can be had than at present by using a form simpler than 1086, as it is very difficult to get good men already employed to fill out any but the most simple statements.

Each applicant should fill out Form 9-563. It is to be noted in this connection that instructions on the back of this form are superseded by the present letter. When this form has been completed, Form 9-569 or similar letter should be addressed to each of the persons whose names are given as reference and the replies when received should be attached to 9-563 and form part of the application.

REPORT OF CHANGES.

The local boards of examiners shall forward, on the first of each month or as soon thereafter as practicable, to the Commission, through the chief enginner, reports of all the changes that have taken place in the service during the preceding month. These reports shall be made on forms which will be provided for the purpose, and in accordance with the instructions thereon.

Approved: October 18, 1906.

E. A. HITCHCOCK,
Secretary of the Interior.

Approved:

JOHN C. BLACK,
President U. S. Civil Service Commission.

CONTRACTS.

As required by section 3744, Revised Statutes, contracts are executed for all supplies or services, if the contract is not immediately executed by delivery or performance. Such immediate delivery is construed to mean approximately thirty days from the date of the order. In all building contracts the further requirement of a bond for faithful performance is insisted upon. While compliance with section 3744 is frequently expensive and annoying—as on an agreement for telephone service, for short rentals, or for minor agreements not performed within thirty days—and its requirements might properly be modified with advantage to the Government, yet, in the main, it works well, and most of the contracts are of a nature which good business judgment requires should be made a matter of complete record.

ADVERTISING.

Section 3709, Revised Statutes, requires that in securing all supplies and all services, other than personal, competition shall be sought through advertising, except when public exigency requires the immediate delivery of supplies or the immediate performance of service. This requirement is being complied with at all points, though with considerable annoyance at times and occasionally probably without benefit to the Government. When proposals are invited for the execution of a large work or for the delivery of large quantities of materials or supplies, an advertisement is inserted in such periodicals as will secure the widest publicity among possible bidders. When bids are desired upon smaller quantities or upon articles or services that can be secured only in local markets, circular advertisements are sent to all dealers within a reasonable distance and posted in public places, as in the local offices of the Reclamation Service and in post-offices. All proposals submitted are open for the inspection of bidders, and all papers, with the report of the board recommending the award, are carefully filed.

It is believed that if section 3709 could be so amended as to leave it to Executive discretion whether to advertise for purchases amounting to less than $500, there would be no loss to the Government in prices obtained; and, on the other hand, there would be a material saving in clerical labor. Advertising is economical and advisable when the difference in amount between possible maximum and minimum bids is in excess of the costof advertising. In other cases no saving can result.

ACCOUNTING.

During the earlier period of operations under the reclamation act the character of the work did not require nor lend itself to elaborate and detailed bookkeeping records. As work progressed it became apparent that a comprehensive scheme of accounts was essential in order to have: (1) The necessary information upon which to plan for the future use of the fund; (2) complete accounts showing the costs of each project, so that the costs of construction would be returned to the Government, and (3) comparative statements tending to show the relative economy of different styles of construction and of different methods and appliances. During the past year the records of all fiscal transactions have been gone over carefully, rechecked, and corrected, where necessary. The number of vouchers during the past fiscal year was 23,533, and from July 9, 1902, to June 30, 1906, was something in excess of 90,000. These are all charged to project accounts, either directly upon payment or subsequently by the prorating of certain general expense accounts to which the expenditures have first been charged. Much thought has also been put upon the subject of a uniform system of accounting for the field offices, and a committee consisting of the accountant, a special disbursing agent, and a public accountant from a firm of national repute recently visited several projects studying this subject. The idea has been to have very complete and detailed records at the field offices and to keep in the Washington office only enough detail to make the figures intelligible and to give the administrative force a complete grasp of conditions

COST KEEPING.

Allied to bookkeeping proper is the kindred subject of cost keeping. Bookkeeping is concerned with the fiscal statements only. Cost keeping analyzes such statements to get at their meaning. From such analyses policies are shaped as to future operations. A very complete system is in operation, and its results have already been found to be of great value to the engineers of the Service.

The purpose of keeping such costs is twofold—first, it enables the engineer to adopt the most economical methods and to select, arrange, and operate his machinery and men in the most economical manner, and, second, it enables him to estimate and analyze the cost of proposed work with intelligence and precision. Engineering construction costs are therefore the fundamental data of estimates and execution of engineering work, and the engineer who tries to get along without them draws conclusions without known premises. The almost inevitable results of such conclusions are financial failure and loss.

The functions of the engineer may be divided into three well-defined classes of work—designing, estimating, and building. An engineer may be called upon to perform any one or more of these functions, and in all cases he will be confronted with the necessity for having accurate information of such costs.

The design of a structure can not be economically made without intimate knowledge of the comparative cost of building material in place. The designer must select concrete, stone, steel, or timber out of which to build his structure. These materials must be considered not from the standpoint of market prices only, but also from the standpoint of permanency and cost of erection. All economical designs are therefore equational functions of variable cost data, the empirical constants of which are necessarily derived from preceding records.

The various structures of any engineering project having been designed properly, the estimate of the cost of the whole, with the varying elements entering into the same, can be determined only by a careful consideration of past information along similar lines. The matter of determining the amount of capital necessary to carry on the work, the expense of the executive force in addition to mere cost of labor, materials, and supplies, must all be largely inferred from the knowledge obtained from preceding experience as formulated for such use.

The constructing engineer is equally concerned in engineering costs. He must know the kind of machinery adapted to a particular kind of work, and must know how to place and manipulate it economically. In the present stage of mechanical invention there are always several devices for doing the same thing. Each one of these devices has its special merits, and a slight variation of the conditions of the work gives opportunity for these several advantages. The engineer must know these merits and these conditions. He must, moreover, know the capacity of each device under given conditions. This he can know only from previous records of output, or what is known as engineering costs or data. In the study of the organization of men the efficiency of the organization can be determined only by careful cost records and comparison with the cost of similar work.

The keeping of engineering construction costs has not yet crystalized into uniform methods. There are about as many practices of compiling information of this character as there are engineers who keep cost records. The degree of completeness and the degree of analysis are so uncertain that valuable comparison is almost impossible. This condition is very unfortunate for the engineering public, and the leading engineering societies of the country could render a good service to the engineering profession by unifying engineering cost-keeping methods.

A comprehensive method of cost keeping must necessarily be based on a logical analysis of the elements of cost pertaining to the work under consideration. The degree to which the analysis should be carried depends on the purpose for which the cost is being compiled and on the magnitude of the work. On small jobs a close analysis is both practical and desirable, but on large works of varied character, such as those being constructed by the United States Reclamation Service, in which the necessity for a method adapted to all items of classification of work exists, it is not advisable to enter into laborious refinement. For such engineering works the methods adopted by the Reclamation Service require the distribution of costs under the following heads: Interest investment; preparatory expenses; plant depreciation; materials; supplies; executive; labor and engineering. These heads are defined to cover expenses as outlined below: (1) Interest investment includes all charges for insurance, bond premium, and interest on cash and borrowed capital. (2) Preparatory expenses includes all charges for the construction of roads, erection and drainage of camps, delivery and installation of plant, and other expenses involved before the actual construction begins. (3) Plant depreciation includes all charges for repairs and the depreciation of tools, machinery, buildings, and the like. (4) Materials includes all charges, including freight, for expendable property entering into the structure and remaining a part thereof. (5) Supplies includes all charges, including freight, for expendable property used in building work and wholly consumed therein. (6) Executive includes all charges for salaries of superintendents, foremen, timekeepers, clerks, watchmen, and for other general administrative expenses. (7) Labor includes all charges for hire of teams and of skilled and common labor not classified in executive. (8) Engineering includes all charges for salaries of engineers and inspectors. In order to distribute the costs properly in this system they are charged directly to the items of the contract to which they apply where possible, and are otherwise prorated during the continuance or at the completion of the contract. For the purpose of facilitating the keeping of costs and of giving full value to the results, the contract items are carefully classified in specification schedules, so as to require bids on each distinctive class of work having a common cost.

The collection of data for this method of cost keeping is made by means of the time-distribution system. In the daily time book, so designed as to serve also as a monthly time book, a separate page is devoted to the records of a single contract item, the entries being made under the heads of engineering, executive, and labor. Likewise a daily-monthly material book is used in which charges against each contract item are similarly made under the heads of plant, materials, and supplies.

The information contained in the daily-monthly time and daily-monthly material books is then carried forward at the end of each month to a ledger, in which entries of monthly progress are made from an estimate book or sheet. In this ledger, accounts are carried with each item of the contract, secondary charges being made under the proper heads hereinbefore mentioned. Certain charges, such as those against investment, interest, preparatory expense, and portions of others are necessarily carried forward en masse until the completion of the contract, at which time distribution is made among the items of the contract.

While figures are always essential to the usefulness of cost data, it is recognized that a complete knowledge of the conditions affecting component prices is equally imperative. The character of machinery, the conditions of labor, the geography of the work, the topography of the site of the work, the proximity of constructing material, the condition of the weather, and other similar circumstances are all important matters for record. Entries in the daily-monthly time books of these elements of cost are, therefore, made by the timekeepers.

UNIT PRICES.

In the tables below are given the unit prices of work on all contracts entered into by the Reclamation Service up to June 30, 1906. In almost all cases contracts have been awarded to the lowest bidder, but as the contracts have been awarded for the work as a whole it has occasionally happened that the contract price for a particular item is higher than the lowest bid on that item.

Unit prices on contract work.

BRIDGES.

Project.	Date.	Feature.	Unit.	Quantity.	Bids per unit—		Contract price per unit.	Distance to railroad station.
					Lowest.	Next.		
								Miles.
Belle Fourche	May 15, 1906	Main supply canal [a]	Bridge	5	$1,173.00	$1,387.00	....	[b] 9½
Do	do	do.[c]	do	5	1,200.00	1,180.00	$1,200.00	[b] 9½
Klamath	Dec. 29, 1905	Main canal [d]	Span	5	1,158.00	1,280.00	1,158.00	36–50
Do	do	do.[e]	do	1	1,038.00	1,230.00	1,038.00	36–50
North Platte	June 29, 1905	North Platte River [f]	Bridge	1	3,384.70	3,690.00	3,384.70	25
Salt River	Jan. 8, 1905	Spillways [g]	do	2	2,575.00	4,000.00	7,500.00	[h] 61 [i] 40
Truckee-Carson	July 15, 1904	Distribution system [j]	do	1	1,090.00	1,500.00	1,090.00	12
Do	do	do.[k]	do	2	950.00	1,150.00	950.00	14½–16
Do	do	do.[l]	do	1	888.00	1,125.00	888.00	17
Do	do	do.[m]	do	2	680.00	1,000.00	680.00	6–7

BUILDINGS.

Project.	Date.	Feature.	Unit.	Quantity.	Lowest.	Next.	Contract price per unit.	Distance to railroad station.
Shoshone	Sept., 1904	Headquarters camp [n]	Building	1	$1,100.00	....	(o)	....
Do	do	do.[p]	do	1	1,330.00	....	(o)	....
Do	do	do.[q]	do	1	870.00	....	(o)	....
Do	do	do.[r]	do	1	330.00	....	(o)	....
Do	do	Construction camp [s]	do	1	475.00	....	(o)	....
Do	do	do.[t]	do	1	350.00	....	(o)	....
Uncompahgre Valley	Dec. 31, 1904	Headquarters [u]	do	1	4,166.00	....	$4,166.00	....
Do	do	do.[v]	do	1	800.00	....	800.00	....

[a] Plans of U. S. Reclamation Service.
[b] Average.
[c] Plans submitted by bidder.
[d] Total length, 86 feet.
[e] Total length, 80 feet.
[f] 350 foot-pile; 14 feet wide.
[g] 190 feet long.
[h] Mesa.
[i] Globe.
[j] 66-foot combination bridge; concrete piers.
[k] 54-foot combination bridge; concrete piers.
[l] 48-foot combination bridge; concrete piers.
[m] 36-foot combination bridge; concrete piers.
[n] 24 by 38 feet, office, one-story.
[o] Constructed by force account.
[p] 25 by 60 feet, lodging house, one-story.
[q] 20 by 57 feet, dining room and kitchen.
[r] 22 by 70 feet, stable, one-story.
[s] 18 by 58 feet, bunk house, one-story.
[t] 16 by 54 feet, dining room and kitchen, one-story.
[u] 40 by 40 feet, two-story, exclusive of heat.
[v] Heating only.

Unit prices on contract work—Continued.

CAST IRON (IN PLACE).

Project.	Date.	Feature.	Unit.	Quantity.	Bids per unit—		Contract price per unit.	Distance to railroad station.
					Lowest.	Next.		
								Miles.
Lower Yellowstone	June 1, 1905	Main canal, division 1	Pound	1,000	$0.04	$0.05	$0.05	18-25
Do	do	Main canal, division 2	do	100	.04	.05	.05	25-34
Do	do	Main canal, division 3	do	100	.04	.05	.05	34-40
Do	do	Main canal, division 4	do	100	.05	.0575	.07	a 40-8 b 30-38
Truckee-Carson	Dec. 15, 1904	Laterals, divisions 1 and 2	do	7,300	.085	.09	.085	14-17
Do	do	Laterals, divisions 3, 4, and 5 (old river channel)	do	9,400	.085	.085	.085	8-12
Do	do	Laterals, division 6	do	7,400	.09	.10	.09	10½
Do	July 15, 1903	Head works c	do	34,000	.03	.03	.03	

CONCRETE.

Project.	Date.	Feature.	Unit.	Quantity.	Lowest.	Next.	Contract price per unit.	Distance to railroad station.
Belle Fourche	Oct. 26, 1905	North and south canals	Cubic yard	850	$7.25	$7.90	$7.25	
Do	do	Dam and reservoir	do	21,930	d6.50-7.00	9.50-12.50	6.50-7.00	13
Hondo	Sept. 6, 1904	Canal and reservoir	do	1,600	6.00	6.90	6.90	15
Huntley	July 28, 1905	Structures	do	400	3.73	5.70	3.73	2¼
Do	do	do. e	do	1,200	3.98	7.50	3.98	2½
Do	do	Main canal f	do	2,200	3.50	3.73	7.00	0-6
Do	do	do	do	e 100	4.00	6.00	8.00	0-6
Do	Jan. 15, 1906	Main canal, class 1	do	2,200	5.00	5.75	5.75	
Do	do	Main canal, class 2	do	1,000	7.00	9.50	9.50	
Klamath	Dec. 29, 1905	Main canal, division 1	do	4,000	7.50	8.00	8.00	36-50
Do	do	Main canal, division 1 g	do	g 10	10.00	14.00	15.00	36-50
Do	do	Main canal, division 2	do	g 400	6.80	7.00	7.00	36-50
Do	do	do	do	150	7.50	10.00	12.00	36-50
Do	do	Main canal, division 3	do	350	6.80	7.00	7.00	36-50
Do	do	Tunnel lining	do	3,100	15.00	15.50	16.00	36-50
Lower Yellowstone	June 1, 1905	Structures, division 1 h	do	210	2.75	5.00	5.00	18-25
Do	do	Structures, division 2 h	do	2,500	2.90	5.00	5.00	25-34
Do	do	Structures, division 3 h	do	1,940	2.90	5.00	5.00	34-40
Do	do	Structures, division 4 h	do	1,690	2.75	6.25	6.25	40-48
Do	do	Structures, division 1 i	do	4,850	2.60	4.25	4.25	18-25
Do	do	Structures, divisions 2 and 3 i	do	250	2.75	4.25	4.25	25-40
Do	do	Structures, division 4 i	do	100	2.60	5.75	5.75	a 40-48 b 30-38
Do	May 10, 1906	Dam	do	220	6.50	9.50	(j)	18
Minidoka	July 2, 1904	Dam, core wall	do	1,000	4.32	6.00	6.00	6½
Do	do	Dam, spillway	do		4.32	4.50	5.00	

Do	do	Canal	do		4.32	4.50	7.00	
Do	do	Canal, river diversion channel	do		4.82	6.00	8.00	
Payette-Boise	Feb. 1, 1906	Dam and headworks	do	5,000	6.00	6.50	6.00	8
Do	do	Bridges, main canal	do	500	8.00	10.00	8.00	0-10
Do	do	Turnouts, main canal	do	2,800	7.00	12.50	7.00	0-10
Do	do	Culverts and drops, main canal	do	1,100	8.00	12.50	8.00	0-10
Do	do	Upper Deer Flat embankment	do	2,500	4.50	5.00	(j)	0-10
Do	do	Lower Deer Flat embankment	do	1,500	4.75	5.00	5.00	0-10
Do	do	Structures on canal	do	600	8.00	12.50	8.00	0-10
Salt River	Jan. 8, 1905	Bridge piers, spillway	do	600	3.40	4.00	6.00	[k]61 [l]40
Truckee-Carson	July 15, 1904	Headworks, Carson River	do	2,675	6.00	6.65	6.65	6
Do	do	Distributing canal			8.00	8.00	8.50	
Do	Aug. 28, 1903	Truckee headworks, division 1	do	3,000	6.00	6.00	6.00	
Do	do	Canal lining, etc	do	30,000	5.50		5.50	
Do	Dec. 15, 1904	Turnouts and bridges, laterals, divisions 1, 2	do	575	10.50	12.00	10.50	14-17
Do	do	Turnouts and bridges, laterals, division 3	do	286	10.50	12.00	12.00	8
Do	do	Turnouts and bridges, laterals, division 4	do	400	10.50	12.00	12.00	12
Do	do	Foundation of power house, lateral, division 6	do	3,260	12.00	14.00	12.00	10½
Umatilla	June 28, 1906	Cold Springs dam, main spillway wall	do	1,250	5.50	10.00	(l)	6
Do	do	Cold Springs dam, wing walls	do	500	6.50	11.00	(l)	6
Do	do	Cold Springs dam, outlet and inlet	do	800	10.50	12.00	(l)	6
Do	do	Cold Springs dam, training wall	do	560	5.70	14.00	( )	6
Do	June 29, 1906	Structures and dam, feed canal	do	925	5.50	10.00	5.50	0-6
Do	do	Canal lining, feed canal, sch. 1	do	1,215	6.00	11.00	6.00	0-6
Do	do	Structures and dam, feed canal sch. 2	do	65	7.00	7.50	7.50	0-6
Do	do	Canal lining, feed canal sch. (?)	do	85	6.75	8.50	8.50	0-6
Uncompahgre Valley	Sept. 26, 1905	Gunnison tunnel, concrete lining and portal masonry	do	2,000	6.75	7.00	6.75	8
Yuma	June 5, 1905	Core wall, Laguna dam	do	27,150	4.00	4.00	4.00	12

CONCRETE MASONRY.

Payette-Boise	Feb. 1, 1906	Dam and headworks	Cubic yard	15,000	$4.75	$5.00	$5.00	8

DRIFT BOLTS.

Payette-Boise	Feb. 1, 1906	Dam and headworks	Pound	20,000	$0.04	$0.07	$0.07	8

[a] Northern Pacific Railroad.
[b] Great Northern Railroad.
[c] Railroad-iron grillage.
[d] Depending on the particular structure in which the concrete was to be used.
[e] Steel reenforcement.
[f] Reenforcement steel furnished by United States.
[g] Reenforced.
[h] Class 1, broken stone, less than ¾ inch.
[i] Class 2, broken stone less than 2½ inches.
[j] Bids rejected.
[k] Mesa.
[l] Globe.

Unit prices on contract work—Continued.

EARTH PLACING.

Project.	Date.	Feature.	Unit.	Quantity.	Bids per unit—		Contract price per unit.	Distance to railroad station.
					Lowest.	Next.		
								Miles.
Minidoka	July 2,1904	Rock in dam	Cubic yard	110,000	$0.40	$0.45	$0.90	6½
Do	do	Earth in dam	do	101,000	.35	.40	.80	
Do	do	Rock in spillways	do	8,000	.75	.75	.75	6½
Do	do	Earth in spillways	do	7,200	.22½	.30	.50	
Payette-Boise	Feb. 1,1906	Lower Deer Flat embankment	do	850,000	.23	.24	.24	9
Yuma	June 5,1905	Rock in Laguma dam	do	305,000	.09	.28	.35	12

ELECTRICAL POWER PLANT.

Project.	Date.	Feature.	Unit.	Quantity.	Lowest.	Next.	Contract price per unit.	Distance to railroad station.
Garden City	May 28,1906	Steam turbine	Plant	1	$46,300.00	$49,200.00	$46,300.00	
Do	do	Reciprocating engines	do	1	48,424.00	57,200.00		
Do	do	Gas engine	do	1	86,170.00	94,790.00		

EXCAVATION, CLASS 1.—LOOSE MATERIAL PLOWABLE WITH 4 HORSES.

Project.	Date.	Feature.	Unit.	Quantity.	Lowest.	Next.	Contract price per unit.	Distance to railroad station.
Belle Fourche	Oct. 26,1905	Dam	Cubic yard	18,000	$0.15	$0.25	$0.30	13
Do	do	Structures	do	6,000	.25	.42	.50	13
Do	do	Dam embankment	do	1,580,000	.28	.325	.28	13
Do	do	Stripping borrow pits	do	35,000	.16	.18	.16	13
Do	do	Trimming dam embankment	do	30,000	.25	.25	.30	13
Do	do	Grading	do	230,000	.18	.199	.20	13
Do	do	Canals, stripping borrow pits	do	6,000	.15	.18	.15	13
Do	do	Grading	do	351,500	.165	.175	.165	13
Do	do	Excavation from borrow pits	do	45,000	.15	.165	.165	13
Do	do	Main canal	do	800,000	.129	.13	.129	2- 9
Klamath	Dec. 29,1905	Main canal, division 1	do	6,700	.18	.18	.18	36-50
Do	do	Main canal, division 2	do	237,800	.18	.19	.18	36-50
Do	do	Main canal, division 3	do	250,000	.18	.188	.18	36-50
North Platte	May 16,1905	Interstate canal, first contract, division 1	do	260,000	.1199	.1325	.1199	
Do	do	Interstate canal, first contract, division 2	do	330,000	.1199	.12	.1199	
Do	do	Interstate canal, first contract, division 3	do	280,000	.1199	.125	.12½	
Do	do	Interstate canal, first contract, division 4	do	450,000	.1199	.14	.15	
Do	do	Interstate canal, first contract, division 5	do	346,000	.13⅓	.14	.14	
Do	do	Interstate canal, first contract, division 6	do	300,000	.1099	.117	.1099	
Do	do	Interstate canal, first contract, division 7	do	300,000	.1099	.117	.1099	

Do	do	Interstate canal, first contract, division 8	do	295,000	.1199	.12	.12	....
Do	do	Interstate canal, first contract, division 9	do	282,000	.1099	.117	.1099	....
Do	do	Interstate canal, first contract, division 10	do	250,000	.1099	.117	.1099	....
Do	Nov. 8, 1905	Interstate canal, second contract, division 1	do	370,000	.1398	.15	.1398	3
Do	do	Interstate canal, second contract, division 2	do	400,000	.13	.15	.13	8
Do	do	Interstate canal, second contract, division 3	do	380,000	.145	.15	.145	6
Do	do	Interstate canal, second contract, division 4	do	330,000	.13	.15	.13	2
Do	do	Interstate canal, second contract, division 5	do	300,000	.13	.138	.13	6
Do	do	Interstate canal, second contract, division 6	do	340,000	.138	.15	.138	9
Do	do	Interstate canal, second contract, division 7	do	380,000	.16	.16	.16	10
Do	do	Interstate canal, second contract, division 8	do	240,000	.135	.15	.135	7
Do	June 15, 1906	Distribution system, section 1	do	129,800	.175	.20	(a)	3
Do	do	Distribution system, section 2	do	37,000	.225	.235	(a)	8
Do	do	Distribution system, section 3	do	37,900	.26	.265	(a)	6
Do	do	Distribution system, section 4	do	79,900	.18	.225	(a)	2
Do	do	Distribution system, section 5	do	65,000	.175	.23	(a)	6
Do	do	Distribution system, section 6	do	94,000	.165	.175	(a)	9
Do	do	Distribution system, section 7	do	32,000	.23	.245	(a)	10
Do	do	Distribution system, section 8	do	76,400	.18	.19	(a)	7
Do	do	Distribution system, section 9	do	53,000	.21	.22	(a)	6
Do	do	Distribution system, section 10	do	19,000	.28	.29	(a)	6
Do	do	Distribution system, section 11	do	20,300	.30	.31	(a)	8
Do	do	Distribution system, section 12	do	24,400	.30	.31	(a)	10
Do	do	Distribution system, section 13	do	37,500	.25	.26	(a)	10
Do	do	Distribution system, section 14	do	11,300	.225	.24	(a)	14
Truckee-Carson	July 15, 1903	Main canal, division 1	do	716,264	.20	.22	.23	0
Do	do	Main canal, division 2	do	668,306	.20	.20	.23	0
Do	do	Main canal, division 3	do	795,714	.20	.24	20	1-7
Do	Dec. 15, 1905	Laterals, division 1	do	185,120	.135	.15	.135	14
Do	do	Laterals, division 2	do	254,581	.135	.155	.135	17
Do	do	Laterals, division 3	do	144,008	.135	.14	.14	8
Do	do	Laterals, division 4	do	358,146	.135	.14	.14	12
Do	do	Laterals, division 5	do	272,556	.15	.155	.15	16
Do	do	Laterals, division 6	do	29,670	.15	.60	.15	10½
Uncompahgre Valley	Sept. 15, 1904	South canal, division 1	do	28,558	.12	.135	.12	7
Do	do	South canal, division 2	do	15,795	.12	.14	.12	8½
Do	do	South canal, division 3, 4	do	46,805	.13	.14	.14	8½
Do	do	South canal, division 5	do	16,331	.13	.14	.14	8
Do	do	South canal, division 6	do	20,212	.11	.13	.11	8½
Do	do	South canal, division 7	do	32,261	.12	.125	.12	9
Do	do	South canal, division 8	do	24,613	.12	.125	.12	8½
Do	do	South canal, division 9	do	19,874	.12	.14	.12	8½

[a] Bids rejected.

Unit prices on contract work—Continued.

EXCAVATION, CLASS 1A.—MATERIAL PLOWABLE WITH 6 HORSES.

Project.	Date.	Feature.	Unit.	Quantity.	Bids per unit—		Contract price per unit.	Distance to railroad station.
					Lowest.	Next.		
								Miles.
Hondo, N. Mex	Sept. 6, 1904	Diversion dam and inlet	Cubic yard	74,000	$0.125	$0.135	$0.125	13
Do	do	Stripping	do	1,000	.125	.15	.15	13
Do	do	Outlet works	do	288,000	.125	.145	.125	13
Do	do	Embankments Nos. 1, 2, 3	do	80,000	.125	.145	.125	13
Do	do	Embankment No. 4	do	162,000	.14	.15	.14	13
Do	do	Structures	do	100	.15	.16	.15	13
Huntley	June 28, 1905	Main canal, division 2	do	305,000	.115	.139	.139	0-6
Do	do	Main canal, division 3	do	350,000	.12	.15	.15	6-17
Do	Jan. 15, 1906	Main canal, division 1	do	65,000	.20	.25	.20	
Do	June 20, 1906	Main canal, division 3 and high line canal	do	350,000	.22	.23	.22	6-17
Lower Yellowstone	June 1, 1905	Main canal, division 1	do	1,077,000	.1425	.1475	.1425	18-25
Do	do	Main canal, division 2	do	1,052,000	.145	.145	.145	25-34
Do	do	Main canal, division 3	do	1,042,000	.129	.145	.129	34-40
Do	do	Main canal, division 4	do	411,000	.12	.14	.12	a 40-48 b 30-38
Do	do	Structures, division 1	do	18,000	.24	.25	.24	18-25
Do	do	Structures, division 2, 3	do	7,500	.24	.25	.24	25-40
Do	do	Structures, division 4	do	4,500	.25	.30	.25	a 40-48 b 30-38
Do	Nov. 15, 1905	Main canal, division 8	do	38,000	.12	.165	.165	6
Do	do	Laterals, F. O. P.	do	138,700	.13	.16	.16	9
Do	Apr. 12, 1906	Main canal, division 2	do	106,500	.22		.22	30
Do	do	Main canal, division 4	do	463,200	.179	.18	.18	42
Minidoka	July 2, 1904	Diversion canal	do	16,000	.15	.175	.15	6½
Do	do	Canal and foundation of spillway	do	43,000	.10	.15	.15	6½
Payette-Boise	Feb. 1, 1906	Main south side canal, Boise River to Indian Creek.	do	830,000	.17			4-9
Do	do	Main canal, Indian Creek to Deer Flat Reservoir	do	320,000	.14	.15	.14	
Do	do	Upper Deer Flat embankment	do	20,000	.15	.18	(c)	
Do	do	Lower Deer Flat embankment	do	40,000	.15	.17	.15	
Do	Apr. 16, 1906	Main south side canal, Boise River to Indian Creek, Sch. 1.	do	355,000	.18	.21		
Do	do	Main south side canal, Boise River to Indian Creek, Sch. 2.	do	245,000	.15	.155	.15	
Do	do	Main south side canal, Boise River to Indian Creek, Sch. 3.	do	230,000	.165	.17	.165	
Shoshone	May 24, 1906	Garland canal, division 1	do	138,000	.25		(c)	
Do	do	Garland canal, division 2	do	117,000	.25		(c)	
Do	do	Garland canal, division 6	do	85,000	.25		(c)	
Truckee-Carson	July 15, 1904	Distributing system, division 1	do	267,044	.15	.16	.15	7½
Do	do	Distributing system, division 2	do	194,012	.13	.14	.13	11

Do	do	Distributing system, division 3	do	245,383	.13	.14	.13	11½
Do	do	Distributing system, division 4	do	187,630	.13	.1325	.15	13
Do	do	Distributing system, division 5	do	179,998	.12	.1325	.12	19
Do	do	Distributing system, division 6	do	228,388	.12	.1325	.12	16
Do	do	Distributing system, division 7	do	306,340	.12	.1325	.12	8
Umatilla	June 28, 1906	Cold Springs dam	do	158,000	.31	.418	(c)	6
Do	do	Trenches	do	61,300	.40	.688	(c)	0–6
Do	June 29, 1906	Feed canal, sch. 1	do	333,700	.15	.18	.15	6
Do	do	Feed canal, sch. 2	do	315,800	.14	.165	.14	8½
Uncompahgre Valley	Sept. 26, 1904	Gunnison tunnel, west portal	do	75,000	.16	.16	.16	8½

EXCAVATION, CLASS 1 B.—ALL LOOSE MATERIAL EXCEPT SOLID ROCK AND BOWLDERS ABOVE 10 CUBIC FEET.

Salt River	Jan. 8, 1905	Roosevelt dam	Cubic yard	50,000	$0.75	$0.96	$1.75	[d]61, [e]40
Yuma	June 5, 1905	Laguna dam	do	305,000	.23	.30	.30	12

EXCAVATION 1 C.—MATERIAL PLOWABLE WITH 10 HORSES.

Payette-Boise	Feb. 1, 1906	Main southside canal, Boise River to Indian Creek, sch. 2	Cubic yard	56,500	$0.40	....	$0.40	[f]8
Do	do	Main southside canal, Indian Creek to Deer Flat reservoir, sch. 3	do	60,000	.33	$0.35	.35	[f]8
Do	do	Upper Deer Flat embankment	do	5,000	.30	.40	(c)	6–8
Do	do	Lower Deer Flat embankment	do	5,000	.25	.30	.30	8–12

CAVATION, CLASS 2.—INDURATED MATERIAL NOT PLOWABLE, WHERE LOOSENED WITH POWDER REMOVABLE BY SCRAPERS.

Belle Fourche	Apr. 10, 1905	Main supply canal	Cubic yard	1,000	$0.25	$0.30	$0.25	2–9
Do	Oct. 26, 1905	Dam and trenches	do	4,000	.20	.40	1.25	13
Do	do	Grading	do	25,000	.35	.40	.42	13
Do	do	North and south canals	do	24,000	.35	.39	.39	14–17
Hondo	Sept. 6, 1904	Outlet excavation and embankment, diversion dam.	do	200	.35	.45	.46	13
Do	do	Stripping	do	100	.35	.45	.46	13
Do	do	Structures	do	100	.35	.40	.46	13
Huntley	June 20, 1906	Main canal, division 3, and high line canal	do	100	.60	.90	.60	6–17
Klamath	Dec. 29, 1905	Main canal, division 1	do	....	.35	.55	.35	36–50
Do	do	Main canal, division 2	do	....	.35	.42	.35	36–50
Do	do	Main canal, division 3	do	....	.35	.35	.35	36–50
Lower Yellowstone	June 1, 1905	Main canal, division 1, 2, 3, 4	do	4,300	.28	.30	....	18–40
Do	do	Main canal, division 1	do	1,000	.28	.30	.28	18–25
Do	do	Main canal, division 2	do	1,300	.30	.30	.30	25–34

[a] Northern Pacific Railroad. [b] Great Northern Railroad. [c] Bids rejected. [d] Mesa. [e] Globe. [f] Average.

Unit prices on contract work—Continued.

EXCAVATION, CLASS 2.—INDURATED MATERIAL NOT PLOWABLE, WHERE LOOSENED WITH POWDER REMOVABLE BY SCRAPERS—Continued.

Project.	Date.	Feature.	Unit.	Quantity.	Bids per unit—		Contract price per unit.	Distance to railroad station.
					Lowest.	Next.		
								Miles.
Lower Yellowstone	June 1, 1905	Main canal, division 3	Cubic yard	1,200	$0.30	$0.30	$0.30	34-40
Do	do	Main canal, division 4	do	800	.28	.30	.30	[a] 40-48 [b] 30-38
Do	do	Structures, division 1	do	1,500	.34	.40	.34	18-25
Do	do	Structures, divisions 2, 3	do	500	.34	.40	.34	25-40
Do	do	Structures, division 4	do	200	.40	.40	.40	[a] 40-48 [b] 30-38
Do	Nov. 15, 1905	Main canal, division 8	do	1,000	.22	.30	.30	6
Do	do	Laterals, F. O. P.	do	400	.20	.30	.30	(c)
Do	Apr. 12, 1906	Main canal, division 2	do	1,300	.30	.32	1.35	30
Do	do	Main canal, division 4	do	800	.25	.30	.32	42
Minidoka	July 2, 1904	Diversion channel	do	100	.35	.40	.40	6½
Do	do	Canal and spillway	do	100	.35	.40	.40	6½
North Platte	May 16, 1905	Interstate canal, first contract, division 1	do	10,000	.37	.40	.60	
Do	do	Interstate canal, first contract, division 2	do	100	.37	.41	.60	
Do	do	Interstate canal, first contract, division 3	do	27,000	.29	.37	.50	
Do	do	Interstate canal, first contract, division 4	do	79,000	.29	.37	.29	
Do	do	Interstate canal, first contract, division 5	do	26,000	.37	.40	.40	
Do	do	Interstate canal, first contract, division 6	do	100	.37	.42	.60	
Do	do	Interstate canal, first contract, division 7	do	100	.20	.40	.60	
Do	do	Interstate canal, first contract, division 8	do	100	.20	.35	.35	
Do	do	Interstate canal, first contract, division 9	do	100	.20	.35	.60	
Do	do	Interstate canal, first contract, division 10	do	100	.20	.30	.60	
Do	Nov. 8, 1905	Interstate canal, second contract, division 1	do	1,000	.55	.60	.55	3
Do	do	Interstate canal, second contract, division 2	do	1,000	.50	.60	.50	8
Do	do	Interstate canal, second contract, division 3	do	24,000	.55	.60	.55	6
Do	Nov. 8, 1905	Interstate canal, 2d contract, division 4	do	1,000	.55	.60	.55	2
Do	do	Interstate canal, 2d contract, division 5	do	1,000	.45	.55	.55	6
Do	do	Interstate canal, 2d contract, division 6	do	60,000	.45	.48	.48	9
Do	do	Interstate canal, 2d contract, division 7	do	30,000	.45	.50	.45	10
Do	do	Interstate canal, 2d contract, division 8	do	20,000	.45	.55	.55	7
Do	June 15, 1906	Distributing system, all sections	do	6,900	.75	.75		
Payette-Boise	Feb. 1, 1906	Main South side canal, Boise River to Indian Creek	do	56,500	.40			[e] 8
Do	do	Main South side canal, Indian Creek to Deer Flat Reservoir.	do	16,000	.48	.50	.50	[e] 8
Do	do	Upper Deer Flat embankment	do	5,000	.35	.50	(d)	
Do	do	Lower Deer Flat embankment	do	5,000	.35	.50	.35	10-12
Do	Apr. 16, 1906	Main South side canal, Boise River to Indian Creek, sch. 1.	do	33,000	.45	.50	.45	[e] 8
Do	do	Main South side canal, Boise River to Indian Creek, sch. 2.	do	40,000	.45	.50	.50	[e] 8

Do	do	Main South side canal, Boise River to Indian Creek, sch. 3.	do	50,000	.40	.45	.40	10-12
Umatilla	June 28, 1906	Cold Springs dam	do	19,300	.60	1.53	(d)	6
Do	June 29, 1906	Storage Feed canal, sch. 1	do	48,400	.45	.65	.45	e 4
Do	do	Storage Feed canal, sch. 2	do	5,000	.44	.45	.45	6
Truckee-Carson	July 15, 1903	Main canal, division 1	do	60,000	.30	.40	.30	7-16
Do	do	Main canal, division 2	do	14,247	.30		.30	
Do	do	Main canal, division 3	do	125,178	.40	.50	.50	13-19
Do	July 15, 1904	Distributing system, divisions 1, 2, 3, 6, 7	do	91,223	.25	.32	.25	
Do	do	Distributing system, divisions 4, 5	do		.20	.25	.25	12-16
Do	do	Laterals and ditches, divisions 1, 2	do		.35	.45	.45	14-17
Do	do	Laterals and ditches, division 3	do		.35	.45	.35	
Do	do	Laterals and ditches, division 4	do		.25	.35	.35	12
Do	do	Laterals and ditches, division 5	do		.1685	.25	.25	16
Do	do	Laterals and ditches, division 6	do		.50	.75	.50	10½
Uncompahgre Valley	Aug. 28, 1904	South canal, division 1	do	8,000	.25	.27	.28	7
Do	do	South canal, division 2	do	11,073	.25	.27	.28	8½
Do	do	South canal, divisions 3, 4	do	24,000	.25	.27	.25	8½
Do	do	South canal, division 5	do	15,000	.21	.25	.25	8
Do	do	South canal, division 6	do	6,000	.15	.25	.15	8
Do	do	South canal, divisions 7, 8	do	10,000	.25	.25	.28	8½-9
Do	do	South canal, division 9	do	10,000	.25	.25	.28	8½
Do	do	Gunnison tunnel, Cedar Creek portal	do	15,000	.23	.35	.23	8½

EXCAVATION, CLASS 3.—LOOSE ROCK 2 TO 10 CUBIC FEET.

Huntley	June 28, 1905	Structures	Cubic yard	500	$0.40	$0.65	$1.00	0-6
Lower Yellowstone	June 1, 1905	Main canal, division 1	do	1,000	.30	.37	.10	18-25
Do	do	Main canal, division 2	do	1,200	.30	.37	.30	25-34
Do	do	Main canal, division 3	do	800	.30	.40	.30	34-40
Do	do	Main canal, division 4	do	1,200	.30	.35	.30	a 40-48 b 30-38
Do	do	Structures, division 1	do	1,000	.45	.50	.50	18-25
Do	do	Structures, divisions 2, 3	do	500	.50	.50	.50	25-40
Do	do	Structures, division 4	do	300	.50	.60	.50	a 40-48 b 30-38
Do	do	Canal and structures 1, 2, 3, 4	do	6,000	.35			
Do	Nov. 15, 1905	Main canal, divivion 8	do	1,000	.38	.50	.50	6
Do	do	Lateral F	do	200	.35	.50	.50	22
Do	do	Laterals O and P	do	200	.38	50	.50	9
Truckee-Carson	July 15, 1903	Distributing system, divisions 1, 2, 7	do		.35	.35	.35	7½-19
Do	do	Distributing system, divisions 3, 6	do		.35	.37	.35	11½-11
Do	do	Distributing system, divisions 4, 5	do		.30	.35	.30	13-16

[a] Northern Pacific Railroad.
[b] Great Northern Railroad.
[c] F., 22; O. P., 9.
[d] Bids rejected.
[e] Average.

Unit prices on contract work—Continued.

EXCAVATION, LOOSE ROCK NOT EXCEEDING ½ CUBIC YARD.

Project.	Date.	Feature.	Unit.	Quantity.	Bids per unit— Lowest.	Bids per unit— Next.	Contract price per unit.	Distance to railroad station.
								Miles.
Lower Yellowstone	Apr. 12, 1906	Main canal, division 2	Cubic yard	1,200	$0.60		$0.60	30
Do	do	Main canal, division 4	do	1,200	.45	$0.50	.45	42
North Platte	May 16, 1905	Interstate canal, first contract, division 1	do	100	.35	.35	.35	
Do	do	Interstate canal, first contract, division 2	do	100	.35	.75	.75	
Do	do	Interstate canal, first contract, division 3	do	100	.35	.35	.35	
Do	do	Interstate canal, first contract, division 4	do	100	.35	.35	.35	
Do	do	Interstate canal, first contract, division 5	do	100	.35	.35	.35	
Do	do	Interstate canal, first contract, division 6	do	100	.35	.35	.75	
Do	do	Interstate canal, first contract, division 7	do	100	.30	.35	.75	
Do	do	Interstate canal, first contract, division 8	do	100	.30	.35	.75	
Do	do	Interstate canal, first contract, division 9	do	100	.30	.35	.75	
Do	do	Interstate canal, first contract, division 10	do	100	.30	.35	.75	
Do	Nov. 8, 1905	Interstate canal, second contract, division 1	do	100	.45	.65	.45	3
Do	do	Interstate canal, second contract, division 2	do	100	.45	.65	.45	8
Do	do	Interstate canal, second contract, division 3	do	100	.45	.65	.45	6
Do	do	Interstate canal, second contract, division 4	do	100	.45	.65	.45	2
Do	do	Interstate canal, second contract, division 5	do	100	.45	.50	.45	6
Do	do	Interstate canal, second contract, division 6	do	100	.45	.50	.50	9
Do	do	Interstate canal, second contract, division 7	do	100	.45	.55	.55	10
Do	do	Interstate canal, second contract, division 8	do	100	.45	.50	.45	7
Do	June 15, 1906	Distribution system	do	2,400	.80	.80	.80	
Payette-Boise	Feb. 1, 1906	Main south side canal, Boise River to Indian Creek.	do	32,000	.70		.70	[a] 8
Do	do	Main south side canal, Indian Creek to Deer Flat Reservoir.	do	3,800	.70	.70	.70	[a] 8
Do	Apr. 16, 1906	Main south side canal, Boise River to Indian Creek, sch. 1.	do	10,000	.55	.60	.55	[a] 8
Do	do	Main canal, Boise River to Indian Creek, sch. 2	do	11,000	.55	.60	.80	[a] 8
Do	do	Main canal, Boise River to Indian Creek, sch. 3	do	11,000	.55	.70	.70	10–12
Shoshone	May 24, 1906	Garland canal, division 1	do	14,000	.60		(b)	1
Do	do	Garland canal, division 2	do	100	.60		(b)	2
Do	do	Garland canal, division 6	do	100	.60		(b)	7

EXCAVATION, CLASS 3A.—LOOSE ROCK UP TO 20 CUBIC FEET.

Project.	Date.	Feature.	Unit.	Quantity.	Bids per unit— Lowest.	Bids per unit— Next.	Contract price per unit.	Distance to railroad station.
Huntley	June 28, 1905	Main canal, division 2	Cubic yard	100	$0.30	$0.30	$0.80	0–6
Do	do	Main canal, division 3	do	100	.30	.40	.30	6–17

EXCAVATION, CLASS 3B.—LOOSE ROCK UP TO 1 CUBIC YARD.

Belle Fourche	Apr. 10, 1905	Main supply canal	Cubic yard	1,000	$0.39	$0.40	$0.56	2-9
Hondo	Sept. 6, 1904	Inlet and dam, division 1	do	100	.35	.37	.65	13
Do	do	Stripping, division 2	do	100	.37	.40	.40	
Do	do	Outlet excavation and embankment, division 3	do	100	.35	.37	.65	13
Do	do	Structures	do	100	.60	.65	.65	
Huntley	Jan. 15, 1906	Main canal, division 1 [c]	do	1,000	.45	.60	.45	0-6
Minidoka	July 2, 1904	Diversion channel	do	1,000	.45	.55	.65	6½
Do	do	Canal and foundation of spillway	do	1,000	.40	.45	.65	
Truckee-Carson	Dec. 15, 1904	Laterals and structures, division 3	do		.35	.37	.35	8
Do	do	Laterals and structures, division 4	do	6,112	.30	.35	.35	12
Uncompahgre Valley	Oct. 5, 1904	Gunnison tunnel, Cedar Creek portal	do	5,000	.30	.40	.30	8
Do	Sept. 15, 1904	South canal, divisions 1, 2	do	4,000	.32	.34	.34	7-7½
Do	do	South canal, divisions 3, 4	do	13,000	.32	.34	.35	8½
Do	do	South canal, division 5	do	7,500	.33	.34	.35	8
Do	do	South canal, division 6	do	2,000	.31	.34	.50	8½
Do	do	South canal, divisions 7, 8	do	4,000	.31	.34	.34	8½-9
Do	do	South canal, division 9	do	5,000	.32	.34	.34	8½

EXCAVATION, GRAVEL FOR DAM.

Umatilla	June 28, 1906	Cold Springs dam	Cubic yard	455,000	$0.4185	$0.45	([d])	6

EXCAVATION, CLASS 4.—SOLID ROCK REQUIRING DRILLING AND BLASTING.

Belle Fourche	Apr. 10, 1905	Supply canal	Cubic yard	1,000	$0.85	$0.89	$1.25	2-9
Do	Oct. 26, 1905	Dam	do	1,000	.80	1.00	1.05	13
Do	do	North canal	do	1,000	.80	1.00	1.05	[e] 14
Do	do	South canal	do		.80	.99	.99	[e] 17
Hondo, N. Mex	Sept. 6, 1904	Reservoir and canal	do	30,000	.69	.83	.69	13
Do	do	Structures	do	100	.70	.85	1.50	13
Huntley	June 28, 1905	Main canal, division 2	do	100	.75	.80	.20	0-6
Do	do	Main canal, division 3	do	100	.80	.80	.80	6-17
Do	do	Structures	do	500	.90	1.25	2.00	2½
Do	Jan. 15, 1906	Main canal, division 1	do	16,000	1.00	1.10	1.00	
Do	June 20, 1906	Main canal, division 3 and high line canal	do	100	1.50	1.50	1.50	6-17
Klamath	Dec. 29, 1905	Main canal, division 1	do	35,700	.68	1.00	1.25	36-50
Do	do	Main canal, division 2	do	100	.85	1.10	1.25	36-50
Do	do	Main canal, division 3	do	100	.60	1.10	1.25	36-50
Lower Yellowstone	June 1, 1905	Main canal, division 1	do	1,000	.60	.75	.90	18-25
Do	do	Main canal, divisions 2, 4	do	1,100	.65	.75	.65	25-40
Do	do	Main canal, division 3	do	100	.65	.75	.65	34-40
Do	do	Structures, division 1	do	1,300	.60	.95	.60	18-25

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[a] Average. [b] One bid, rejected. [c] Loose rock and hardpan. [d] Bids rejected. [e] Up.

Unit prices on contract work—Continued.

EXCAVATION, CLASS 4.—SOLID ROCK REQUIRING DRILLING AND BLASTING.

Project.	Date.	Feature.	Unit.	Quantity.	Bids per unit—		Contract price per unit.	Distance to railroad station.
					Lowest.	Next.		
								Miles.
Lower Yellowstone	June 1, 1905	Structures, division 2	Cubic yard	10	$0.60	$1.25	$0.60	25–34
Do	do	Structures, division 3	do	10	.60	.60	.60	34–40
Do	do	Structures, division 4	do	10	1.00	1.25	1.50	[a] 40–4 [b] 30–38
Do	Nov. 15, 1905	Main canal, division 8	do	20	1.50	1.55	1.50	6
Do	do	Lateral F	do	10	1.50	1.60	1.50	22
Do	do	Laterals O, P	do	10	1.00	1.50	1.50	9
Do	Apr. 12, 1906	Main canal, division 2	do	1,000	1.50		1.50	30
Do	do	Main canal, division 4	do	100	1.50	1.50	1.50	42
Minidoka	July 2, 1904	Diversion channel	do	47,000	.90	1.00	.90	6½
Do	do	Foundation of spillways	do	42,000	.70	.80	.70	6½
Do	July 2, 1905	North canal	do	105,000	.95	1.10	.95	
Do	do	South canal	do	65,000	.95	1.10	.97	
North Platte	May 16, 1905	Interstate canal, first contract, division 1	do	1,500	.65	.67	.80	
Do	do	Interstate canal, first contract, division 2	do	100	.60	.67	.80	
Do	do	Interstate canal, first contract, division 3	do	38,000	.67	.70	.70	
Do	do	Interstate canal, first contract, division 4	do	100	.60	.67	1.00	
Do	do	Interstate canal, first contract, division 5	do	100	.60	.67	.72	
Do	do	Interstate canal, first contract, division 6	do	100	.60	.67	.72	
Do	do	Interstate canal, first contract, division 7	do	100	.60	.60	.80	
Do	do	Interstate canal, first contract, division 8	do	100	.60	.60	.80	
Do	do	Interstate canal, first contract, division 9	do	100	.60	.60	.80	
Do	do	Interstate canal, first contract, division 10	do	100	.60	.60	.80	
Do	Nov. 8, 1905	Interstate canal, second contract, division 1	do	100	.50	.75	.50	3
Do	do	Interstate canal, second contract, division 2	do	100	.50	.75	.50	8
Do	do	Interstate canal, second contract, division 3	do	100	.50	.75	.50	6
Do	do	Interstate canal, second contract, division 4	do	100	.50	.75	.50	2
Do	do	Interstate canal, second contract, division 5	do	100	.50	.75	.50	6
Do	do	Interstate canal, second contract, division 6	do	100	.75	.85	.90	9
Do	do	Interstate canal, second contract, division 7	do	100	.75	.85	.85	10
Do	do	Interstate canal, second contract, division 8	do	100	.55	.75	.55	7
Do	June 15, 1906	Distribution system, sections 1–14	do	1,400	.90	.90		
Payette-Boise	Feb. 1, 1906	Dam and headworks	do	9,000	.90	1.25	1.25	8
Do	do	Main canal, Boise River to Indian Creek	do	10,000	1.40		1.40	[c] 8
Do	do	Main canal, Indian Creek to Deer Flat Reservoir	do	15,000	1.00	1.25	1.25	10–12
Do	Apr. 16, 1906	Main canal, Boise River to Indian Creek, sch. 1a	do	1,000	1.15	1.25	1.25	8
Do	do	Main canal, Boise River to Indian Creek, sch. 1b	do	3,000	1.15		1.15	8
Do	do	Main canal, Boise River to Indian Creek, sch. 2	do	3,000	1.15		1.15	8
Do	do	Main canal, Boise River to Indian Creek, sch. 3	do	3,000	1.15	1.50	1.15	10–12
Salt River	Jan. 8, 1905	Roosevelt dam	do	20,000	1.00	1.25	1.50	[d] 61 [e] 40
Shoshone	May 24, 1906	Garland canal, division 1	do	62,000	1.25		(f)	8

Do	....do	Garland canal, division 2	....do	8,000	1.25	....	(f)	7
Do	....do	Garland canal, division 6	....do	100	1.25	....	(f)	7
Truckee-Carson	July 15, 1903	Main canal, division 1	....do	60,000	.80	.90	.80	0-3
Do	....do	Main canal, division 2	....do	30,000	.80	1.00	.80	0-3
Do	....do	Main canal, division 3	....do	38,000	1.00	1.00	1.00	0-3
Do	July 15, 1904	Distributing systems, divisions 1-7	....do	38,000	.75	.80	.80	6-20
Do	Dec. 15, 1904	Laterals	....	Not stated	.80	.80	.80	6-20
Do	....do	Carson River canal	....	....do	.80	.80	.80	6-16
Umatilla	June 28, 1906	Cold Springs dam	Cubic yard	3,100	1.25	2.70	(g)	6
Do	June 29, 1906	Feed canal, sch. 1	....do	5,920	1.50	1.60	2.00	....
Do	....do	Feed canal, sch. 2	....do	200	.95	1.25	2.00	....
Uncompahgre Valley	Sept. 15, 1904	South canal, divisions 1, 2	....do	....	.75	.95	.95	7-8½
Do	....do	South canal, divisions 3, 4, 5	....do	....	.75	.85	....	8-8½
Do	....do	South canal, division 6	....do	....	.75	.95	1.25	8½
Do	....do	South canal, dvisions 7, 8	....do	....	.95	1.25	.95	8½-9
Do	....do	South canal, division 9	....do	....	.95	.95	.95	8½
Do	....do	Gunnison tunnel, Cedar Creek portal	....do	25,000	.70	.75	.75	8½
Yuma	June 5, 1905	Laguna dam	....do	305,000	1.05	1.05	1.30	12

EXCAVATION, CLASS 4 A.—WET.

Belle Fourche	Apr. 10, 1905	Supply canal	Cubic yard	3,000	$0.75	$1.25	$1.50	2-7
Huntley	June 28, 1905	Main canal, division 1	....do	20,000	.25	.27	.27	0-6
Do	Jan. 15, 1906	....do	....do	13,000	.54	.60	.60	....
Klamath	Dec. 29, 1905	....do	....do	6,700	.56	.75	1.00	36-50
Lower Yellowstone	June 1, 1905	Canal	....do	20,000	.15	.22½	.30	18-48
Do	....do	Structures at headworks	....do	3,400	1.00	1.25	1.25	18
Do	July 21, 1905	Head works	....do	3,400	1.00	1.25	1.25	18
Do	July 22, 1905	Canal	....do	20,000	.15	.22½	.30	18-48
Payette-Boise	Feb. 1, 1906	Dam and headworks	....do	1,000	1.60	2.00	2.00	8
Truckee-Carson	July 15, 1903	....do.[h]	....do	2,000	1.00	2.00	2.00	....
Do	Nov. 11, 1904	Carson headworks[i]	....	....	.25	.75	.75	6

EXCAVATION, CLASS 4 B.—SOLID ROCK UNDER WATER.

Huntley	June 28, 1905	Main canal, division 1	Cubic yard	1,000	$1.00	$1.10	$2.50	0-6
Do	Jan. 15, 1906	....do	....do	5,000	2.50	2.50	2.50	
Klamath	Dec. 29, 1905	....do	....do	100	1.50	2.00	1.50	36-50
Payette-Boise	Feb. 1, 1906	Main canal	....do	4,000	1.50	1.60	2.00	8
Salt River	Jan. 8, 1905	Roosevelt dam	....do	6,000	1.50	2.60	5.00	[d] 61 [e] 40

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[a] Northern Pacific Railroad.
[b] Great Northern Railroad.
[c] Average.
[d] Mesa.
[e] Globe.
[f] Only one bid, rejected.
[g] Bids rejected.
[h] Bowlders and cobblestones in a stream difficult to divert.
[i] Good sand excavated with centrifugal pump.

Unit prices on contract work—Continued.

EXCAVATION OF ALL KINDS FOR STRUCTURES.

Project.	Date.	Feature.	Unit.	Quantity.	Bids per unit—		Contract price per unit.	Distance to railroad station.
					Lowest.	Next.		
								Miles.
Umatilla	June 29, 1906	Storage feed canal, sch. 1	Cubic yard	2,500	$0.60	$0.75	$0.60	6
Do	do	Storage feed canal, sch. 2	do	800	.30	.50	.50	6
EXCAVATION—ALL EXCEPT SOLID ROCK AND BOWLDERS OVER ½ CUBIC YARD.								
Payette-Boise	Feb. 1, 1906	Dam and headworks	Cubic yard	3,000	$0.80	$1.00	$0.80	8
FILL IN CRIBWORK.								
Payette-Boise	Feb. 1, 1906	Dam and headworks	Cubic yard	2,500	$0.50	$0.75	$1.00	8
GATES AND GUIDES.								
Belle Fourche	Apr. 10, 1905	Supply canal (in place)	Pound	56,000	$0.05	$0.05	$0.05	2-9
Do	Oct. 26, 1905	Dam	do	16,000	.07	.08	.085	13
Huntley	June 28, 1905	Structures	do	6,000	.06	.06	.06	
Minidoka	July 2, 1904	Diversion channel	do	46,800	.0516		.0516	6½
Payette-Boise	Feb. 1, 1906	Diverting works, 5 by 9 feet	do	70,000	.0675	.07	.0675	8
Do	do	Diverting works, 5 by 6 feet	do	32,000	.0675	.07	.0675	8
Truckee-Carson	July 15, 1903	Headworks and canals	do	220,000	.07	.07	.07	
Do	July 15, 1904	37 miles distributing system	do	94,000	.0675	.07	.0675	6-20
GATES.								
Belle Fourche	Oct. 26, 1905	Dam [a]	Gate	3	$3,500.00	$3,575.00	$3,575.00	2
Klamath	Dec. 29, 1905	Main canal, division 1	do	6	4,500.00	5,400.00	4,500.00	36-50
Minidoka	July 2, 1904	Diversion channel [b]	do	5	2,900.00		3,700.00	6½
Payette-Boise	Feb. 1, 1906		do	2	500.00	658.00	[c] 1,350.00	8
Truckee-Carson	July 15, 1904	On 37 miles distributing system [d]	do	[e] 1	300.00	325.00	300.00	6-20

Do	do	do. [f]	do	1	250.00	325.00	250.00	6-20
Do	do	do. [g]	do	4	250.00	325.00	250.00	6-20
Do	do	do. [h]	do	2	220.00	325.00	220.00	6-20
Do	do	do. [i]	do	2	220.00	325.00	220.00	6-20
Do	do	do. [j]	do	1	220.00	325.00	220.00	6-20
Do	do	do. [k]	do	2	220.00	325.00	220.00	6-20

GRAVEL FOUNDATION.

Shoshone	May 24, 1906	Garland canal, division 1	Cubic yard	20	$1.00		(l)	8
Do	do	Garland canal, division 2	do	200	1.00		(l)	7
Do	do	Garland canal, division 6	do	60	1.00		(l)	7

LIFTING DEVICES.

Payette-Boise	Feb. 1, 1906	Dam and headworks [m]	Each	8	$201.00	$240.00	$240.00	8
Do	do	do. [n]	do	6	190.00	192.00	190.00	8
Do	do	do. [o]	do	8	214.00	215.50	300.00	8

LUMBER.

Payette-Boise	Feb. 1, 1906	Dam and headworks	Feet B. M.	325	[p] $30.00	[p] $30.00	[p] $30.00	8
Truckee-Carson	July 15, 1903	Temporary channel headworks	do	100,000	[p] 40.00	[p] 40.00	[p] 50.00	0
Do	do	Foot planks	do	5,000	[p] 30.00	[p] 35.00	[p] 40.00	0
Do	Dec. 15, 1904	Laterals, divisions 1, 2	do	81,000	[p] 42.00	[p] 45.00	[p] 45.00	14-17
Do	do	Laterals, division 3	do	72,000	[p] 40.00	[p] 45.00	[p] 40.00	8
Do	do	Laterals, division 4	do	77,000	[p] 37.50	[p] 40.00	[p] 40.00	12
Do	do	Laterals, divisions 1, 2	do	34,500	[p] 50.00	[p] 65.00	[p] 65.00	14-17
Do	do	Bridges, division 3	do	19,000	[p] 50.00	[p] 65.00	[p] 50.00	8
Do	do	Bridges, division 4	do	36,000	[p] 37.50	[p] 50.00	[p] 50.00	12
Do	do	Bridges, division 6	do	4,000	[p] 50.00	[p] 68.00	[p] 68.00	10½
Umatilla	June 29, 1906	Storage feed canal	do	92	[p] 32.00	[p] 35.00	[p] 32.00	6

[a] 4 feet by 6 feet.

[b] 96 inches by 144 inches Coffin rectangular rising screws, ball-bearing standards.

[c] Complete with lifting stems and ball-bearing pedestals to lift 80,000 pounds.

[d] 24 feet 9 inches by 2 feet 6 inches.

[e] Steel rising gates, with guides, ball-bearing standards, screw stems, worm gear, complete, in place.

[f] 20 feet by 2 feet 6 inches.

[g] 7 feet by 3 feet 4 inches.

[h] 14 feet 6 inches by 2 feet 6 inches.

[i] 14 feet 6 inches by 2 feet 1 inch.

[j] 22 feet by 2 feet 1 inch.

[k] 14 feet 6 inches by 3 feet 4 inches.

[l] Only bid, rejected.

[m] Complete ball bearing to lift 20,000 pounds.

[n] Complete ball bearing to lift 15,000 pounds.

[o] Complete ball bearing to lift 30,000 pounds.

[p] Per 1,000 feet B. M.

Unit prices on contract work—Continued.

MASONRY.

Project.	Date.	Feature.	Unit.	Quantity.	Bids per unit—		Contract price per unit.	Distance to railroad station.
					Lowest.	Next.		
								Miles.
Hondo	Sept. 6, 1904	Canal and reservoir	Cubic yard	100	$5.00	$5.00	$8.90	13
Huntley	June 28, 1905	Main canal	do	200	2.25	2.50	3.00	0–6
Do	do	Structures, dry rubble	do	200	3.50	4.00	3.50	2½
Do	Jan. 15, 1906	Rubble wall, main canal, division 1	do	100	3.00	3.50	3.50	....
Salt River	Jan. 8, 1905	Roosevelt dam	do	300,000	3.10	3.15	3.15	[a]61
Do	do	Roosevelt dam coping	do	400	6.00	6.25	20.00	[b]40
Do	do	Roosevelt dam wing walls	do	6,000	3.00	3.25	4.75	....
Shoshone	May 24, 1906	Garland canal, division 1, rubble	do	550	3.50	....	(c)	1
Truckee-Carson	July 15, 1904	Distributing system	do	2,000	5.40	....	5.40	7–1

OVERHAUL.

Project.	Date.	Feature.	Unit.	Quantity.	Lowest.	Next.	Contract price per unit.	Distance to railroad station.
Belle Fourche	Oct. 26, 1905	Dam	Cubic yard per 100 feet.	....	$0.02	....	$0.02	12
Hondo, N. Mex	Sept. 6, 1904	Diversion dam and inlet	do	....	.01	$0.0131	.0131	13
Do	do	Stripping	do	....	.01	.01	.01	13
Do	do	Outlet works	do	....	.01	.0131	.0131	13
Do	do	Embankments, Nos. 1, 2, 3	do	....	.01	.0131	.0131	13
Do	do	Embankment, No. 4	do	....	.01	.0131	.0131	13
Do	do	Structures	do	....	.01	.0131	.0131	13
Huntley	June 28, 1905	Main canal, division 2	do	....	.015	.015	.015	6
Do	do	Main canal, division 3	do	....	.015	.02	.02	6–17
Do	Jan. 15, 1906	Main canal, division 1	do	....	.02	.03	[d].03	....
Lower Yellowstone	June 1, 1905	Main canal, division 1	do	....	.01	.015	.015	18–25
Do	do	Main canal, division 2	do	....	.01	.01	.01	25–34
Do	do	Main canal, division 3	do	....	.01	.01	.01	34–40, 40–48
Do	do	Main canal, division 4	do	....	.01	.01	.01	30–38
Do	do	Structures, division 1	do	....	.015	.015	.015	18–25
Do	do	Structures, divisions 2, 3	do	....	.015	.015	.015	25–40
Do	do	Structures, division 4	do	....	.02	.02	.02	40–48, 30–38
Do	do	Main canal, division 8	do	....	.015	.015	.015	6
Do	do	Laterals F, O, and P	do	....	.015	.015	.015	9
Minidoka	July 2, 1904	Diversion canal	do	....	.01	.015	.015	6½
Do	do	Canal and foundation of spillway	do	....	.01	.015	.015	6½
North Platte	May 16, 1905	Interstate canal, first contract, divisions 1, 2, 6, 7, 8, 9, and 10.	do	....	.01	.01½	.01	....
Do	do	Interstate canal, first contract, division 3	do	....	.01	.01½	.01½	....
Do	do	Interstate canal, first contract, divisions 4 5	do	....	.01	.01½	.02	....

Salt River	Jan. 8, 1905	Roosevelt dam	do		.015		[e].015	
Truckee-Carson	July 15, 1903	Main canal	do		.02		.02	
Do	July 15, 1904	Distributing system, division 1	do		.01	.01	.01	7½
Do	do	Distributing system, division 2	do		.01	.01	.01	11
Do	do	Distributing system, division 3	do		.01	.01	.01	11½
Do	do	Distributing system, division 4	do		.01	.01	.01	13
Do	do	Distributing system, division 5	do		.01	.01	.01	19
Do	do	Distributing system, division 6	do		.01	.01	.01	16
Do	do	Distributing system, division 7	do		.01	.01	.01	8
Do	Dec. 15, 1904	Laterals, division 3	do		.02		.02	11½
Do	do	Laterals, division 4	do		.02		.02	13
Do	do		do		.01		.01	
Do	do	Laterals, division 1	do		.015		.015	7½
Do	do	Laterals, division 2	do		.015		.015	11

PAVEMENT.

Belle Fourche	Apr. 10, 1905	Headworks and dams	Square yard	6,900	$1.75	$2.18	$2.18	13
Huntley	Jan. 15, 1906	Main canal, division 1	do	200	3.00	3.00	3.00	6½
Klamath	Dec. 29, 1905	do	do	6,900	.48	.75	.75	36–50
Do	do	Main canal, division 2	do	500	1.00	2.00	1.00	36–50
Do	do	Main canal, division 3	do	300	1.00	2.00	1.00	36–50
Truckee-Carson	July 15, 1903	Carson headworks	do	4,000	1.35	1.35	1.35	6
Do	Dec. 15, 1904	Laterals, divisions 1 and 2	do	4,700	.50	1.50	1.50	14–17
Do	do	Laterals, division 3	do	7,400	.50	1.50	.50	8
Do	do	Laterals, division 4	do	4,000	.50	1.25	.50	12
Do	do	Power house, lateral 6	do	600	2.00	2.50	2.00	10½
Uncompahgre Valley	Oct. 5, 1904	Gunnison tunnel	do	2,000	1.08	1.35	1.80	7½
Yuma	June 5, 1905	Laguna dam	do	80,000	.90	1.00	1.00	12

PILES DELIVERED.

Lower Yellowstone	June 1, 1905	Canal structures	Linear foot	7,900	$0.18	$0.20	$0.20	18
Truckee-Carson	July 15, 1904	Distributing system [f]	do	7,500	.30	.35	.35	7–16

PILES DELIVERED AND DRIVEN.

Belle Fourche	Oct. 26, 1905	Dam	Linear foot	450	[g]$4.50	[g]$9.00	[g]$11.44	13
Hondo	Sept. 6, 1904	Reservoir and canals	do	75	[g]9.00	[g]12.00	[g]13.00	13
Lower Yellowstone	June 1, 1905	Structures	do	7,500	.38	.40	.40	18

[a] Mesa.
[b] Globe.
[c] Bid rejected.
[d] Over 200 feet.
[e] Over 300 feet.
[f] 12 by 12 piles, 20 feet long.
[g] Per pile.

Unit prices on contract work—Continued.

PILES, DRIVING ONLY.

Project.	Date.	Feature.	Unit.	Quantity.	Bids per unit—		Contract price per unit.	Distance to railroad station.
					Lowest.	Next.		
								Miles.
Truckee-Carson	July 15, 1904	Distributing system	Pile		$2.50	$3.00	$3.00	7-16

PILING (SHEET).[a]

Project.	Date.	Feature.	Unit.	Quantity.	Bids per unit— Lowest.	Bids per unit— Next.	Contract price per unit.	Distance to railroad station.
Belle Fourche	Apr. 10, 1905	Diversion dam	Linear foot	[b] 500	$23.00	$26.00	$26.00	13
Lower Yellowstone	June 1, 1905	Main canal, division 1	do	[c] 800	.07	.135	.135	18-25
Do	do	Main canal, division 2	do	[c] 12,400	.07	.135	.135	25-34
Do	do	Main canal, division 3	do	[c] 6,890	.07	.135	.135	34-40
Do	do	Main canal, division 4	do	[c] 6,000	.07	.15	.15	[d] 40-48 [e] 30-38
Do	do	Main canal, division 1	do	25,000	[f] 21.50	[f] 26.50	[f] 26.50	18-25
Do	do	Main canal, division 2	do	68,800	[f] 22.00	[f] 26.50	[f] 26.50	25-34
Do	do	Main canal, division 3	do	36,200	[f] 22.00	[f] 26.50	[f] 26.50	34-40
Do	do	Main canal, division 4	do	38,800	[f] 22.00	[f] 38.00	[f] 45.00	[d] 40-48 [e] 30-38
Truckee-Carson	July 15, 1903	Main canal, division 1	do	[b] 200	4.25	29.00	29.00	
Do	July 15, 1904	Distributing system	do	[c] 370	.15	.16	.22	6-20
Do		do	do		[g] 1.75		[g] 1.75	6-20
Do		do	do	[c] 320	.15	.15	.18	6-20
Do		do	do		[g] 1.50		[g] 1.50	6-20
Do	July 15, 1904	do	do	[c] 370	.15	.16	.22	
Do	do	do	do	370	[g] 1.75		[g] 1.75	
Do			do	[c] 320	.15	.15	.18	
Do			do	320	[g] 1.50		[g] 1.50	
Yuma	June 5, 1905	Laguna dam	do	[c] 53,000	.329	.37	.40	

PUDDLING.

Project.	Date.	Feature.	Unit.	Quantity.	Bids per unit— Lowest.	Bids per unit— Next.	Contract price per unit.	Distance to railroad station.
Klamath	Dec. 29, 1905	Main canal, division 1	Cubic yard	100	$1.00	$1.00	$1.00	36-50
Do	do	Main canal, division 2	do	100	.30	.75	1.00	36-50
Do	do	Main canal, division 3	do	100	.30	.75	1.00	36-50
Lower Yellowstone	Nov 15, 1905	Lateral F	do	300	.50	1.15	.50	
Do	do	Laterals O, P	do	200	.50	.50	.50	
Do	Apr. 12, 1906	Main canal, division 2	do	2,000	.60		.60	30
Do	do	Main canal, division 4	do	1,000	.60	.75	.75	42
North Platte	May 16, 1906	Interstate canal, first contract, division 1	do	1,000	.30	.35	.75	

Do	do	Interstate canal, first contract, division 2	do	1,000	.30	.40	.75	
Do	do	Interstate canal, first contract, division 3	do	1,000	.30	.40	.75	
Do	do	Interstate canal, first contract, division 4	do	1,000	.30	.40	.50	
Do	do	Interstate canal, first contract, division 5	do	10,000	.30	.40	.43	
Do	do	Interstate canal, first contract, division 6	do	1,000	.30	.40	.75	
Do	do	Interstate canal, first contract, division 7	do	1,000	[h] .05	.30	.75	
Do	do	Interstate canal, first contract, division 8	do	1,000	.30	.40	.60	
Do	do	Interstate canal, first contract, division 9	do	1,000	[h] .03	.30	.75	
Do	do	Interstate canal, first contract, division 10	do	1,000	[h] .05	.30	.75	
Truckee-Carson	July 15, 1903	Truckee canal, division 1	do	1,000	.50	1.50	2.00	
Do	do	Truckee canal	do	1,000	1.50	2.00	2.00	
Do	do	Main canal, division 8	do		.50	1.13	.50	
Do	Dec. 15, 1904	Laterals, divisions 1, 2	do	460	.60	2.00	2.00	6-20
Do	do	Laterals, division 3	do	380	.60	2.00	.60	6-20
Do	do	Laterals, division 4	do	400	.25	.60	.60	6-20
Do	do	Laterals, division 6	do	1,000	2.00	2.00	2.00	6-20

RIPRAP.

Belle Fourche	Apr. 10, 1905	Dam [i]	Square yard	1,250	$1.28	$2.00	$2.50	14
Hondo	Sept. 6, 1904	Dam and inlet canal [j]	do	1,100	.42	.75	.42	13
Do	do	Outlet excavation and embankments 1, 2, 3, 5 [j]	do	16,300	.42	.85	.85	
Do	do	Embankment 4 [j]	do	9,200	.42	.80	.42	
Do	do	Structures [j]	do	408	.42	1.00	.42	
Huntley	June 28, 1905	Main canal, division 1 [j]	Cubic yard	750	1.25	2.75	2.75	1½
Do	do	Main canal, division 2 [j]	do	1,200	1.50	2.00	3.50	0-6
Do	do	Structures [j]	do	1,000	2.50	3.50	3.50	0-6
Do	do	Main canal, division 1 [j]	do	100	2.00	3.00	3.00	0-6
Do	June 20, 1906	Main canal, division 3, and high line canal	do	100	4.00	4.00		40
Lower Yellowstone	June 1, 1905	Main canal, divisions 1, 2, 3 [k]	do	41,100	1.99	1.99	1.99	18-40
Do	do	Main canal, division 4	do	13,530	2.00	2.00	2.00	[d] 40-48 [e] 30-38
Minidoka	July 2, 1904	Dam [l]	Square yard	1,200	.50	.75	2.00	6½
Do	June 15, 1905	Canal [m]	do	12,160	1.00	1.33	1.33	6½
Payette-Boise	Feb. 1, 1906	Dam and headworks	Cubic yard	1,000	1.00	1.50	1.00	8
Do	do	Main south side canal Boise River to Indian Creek	do	3,500	1.25		1.25	8

[a] Each sheet pile shall be formed of three planks of uniform width, thickness, and length, with true tongue and groove, and substantially fastened and well driven in the cases of driving.

[b] Steel, 12 feet long.

[c] Delivered and driven.

[d] Northern Pacific Railroad.

[e] Great Northern Railroad.

[f] Per 1,000 feet B. M., ready to drive.

[g] Driving, each.

[h] Probably an error on the part of the bidder.

[i] Minimum stone dimension, 18 inches.

[j] Stones not less than 1 inch thick.

[k] To be laid on 12-inch base of gravel.

[l] Riprap, 18 inches; minimum stones, 1 foot.

[m] Riprap, 12 inches; minimum stones, 1 foot.

Unit prices on contract work—Continued.

RIPRAP—Continued.

Project.	Date.	Feature.	Unit.	Quantity.	Bids per unit—		Contract price per unit.	Distance to railroad station.
					Lowest.	Next.		
								Miles.
Shoshone	May 24, 1906	Garland Canal, division 1	Cubic yard	100	$3.50		(a)	8
Do	do	Garland Canal, division 2	do	40	3.50		(a)	7
Do	do	Storage feed canal, sch. 6	do	1,200	3.50		(a)	7
Umatilla	June 28, 1906	Cold Springs dam	do	12,000	2.00	$3 375	(b)	6
Do	June 29, 1906	Feed canal, sch. 1	do	3,600	2.50	3.00	$3.00	6
Do	do	Feed canal, sch. 2	do	40	2.00	2.50	3.00	6
Truckee-Carson	July 15, 1903	Headworks [c]	do	500	1.00	2.00	(?)	0

ROADS.

Project.	Date.	Feature.	Unit.	Quantity.	Lowest.	Next.	Contract price per unit.	Distance to railroad station.
Salt River	1904	Entire project	Mile	109			[d] $3,200.00	
Shoshone	1905	Canyon road, 12 feet wide, 2 tunnels	do	4			[d] 12,000.00	
Uncompahgre Valley	1904	Tunnel road	do	10			[d] 1,957.00	

ROCK FILL.

Project.	Date.	Feature.	Unit.	Quantity.	Lowest.	Next.	Contract price per unit.	Distance to railroad station.
Minidoka	July 2, 1904	Dam	Cubic yard	110,000	$0.40	$0.45	$0.90	6½
Do	do	Spillways	do	8,000	.75	.75	.75	6½
Umatilla	June 28, 1906	Cold Springs dam	do	473,000	1.50	2.70	(b)	6
Do	June 29, 1906	Storage feed canal	do	1,000	1.50	1.75	1.50	6
Yuma	Mar. 15, 1905	Laguna dam	do	305,000	.09	.28	.35	12

STEEL.

Project.	Date.	Feature.	Unit.	Quantity.	Lowest.	Next.	Contract price per unit.	Distance to railroad station.
Belle Fourche	Apr. 10, 1905	Diversion dam	Pound	46,200	$0.0475	$0.055	$0.0475	2
Do	do	Supply canal [e]	do	3,000	.046	.07	.07	2-9
Do	Oct. 26, 1905	Reservoir dam [e]	do	16,000	.05	.07	.07	2
Hondo	Feb. 1, 1906	Reservoir and canals [f]	do	100,000	.07	.074	.074	13
Huntley	June 28, 1906	Structures and bridges [e]	do	120,000	.0288	.035	.0288	2½
Lower Yellowstone	June 1, 1906	Structures, division 1 [g]	do	918,000	.004	.0075	.004	18-25
Do	do	Structures, division 2 [g]	do	207,700	.004	.008	.004	25-34
Do	do	Structures, division 3 [g]	do	173,300	.004	.01	.004	34-40

Do	do	Structures, division 4 [g]	do	167,200	.01	.02	.01	40-48 30-38
Do	June 1,1905	Structures, division 1 [f]	do	7,800	.04	.05½	.06	18-25
Do	do	Structures, division 2 [f]	do	16,500	.04	.06	.06	25-34
Do	do	Structures, division 3 [f]	do	7,500	.04	.06	.06	34-40
Do	do	Structures, division 4 [g]	do	8,000	.05	.06½	.08	40-48 30-38
Do	Apr. 12,1906	Concrete reinforcement; size, ½ inch	do	8,700	.016	.01725	.016	18
Do	do	Concrete reinforcement; size, ¾ inch	do	393,000	.015	.016	.016	18
Do	do	Concrete reinforcement; size, 1 inch	do	16,450	.015	.016	.016	18
Do	do	Concrete reinforcement; size, 1¼ inches	do	8,940	.015	.016	.016	18
Minidoka	July 2,1904	South canal	do	30,900	[h] .06	[h] .06	[h] .08	7-20
Payette-Boise	Feb. 1,1906	Culverts and drops on main canal	do	6,500	.07	.075	.09	10
Do	do	Diverting works	do	2,000	.07	.075	.07	8
Do	do	Bridge and canopy, Upper Deer Flat embankment	do	10,000	.04	.125	(b)	8
Do	do	Bridge and canopy, Lower Deer Flat embankment	do	5,000	.04	.08	.04	8
Do	do	Turnouts, main canal	do	4,000	.075	.09	.09	10
Do	do	Reinforcement dam and headworks	do	10,000	.04	.075	.08	8
Do	do	Reinforcement Lower Deer Flat embankment	do	20,000	.04	.04	(b)	8
Do	do	Reinforcement Upper Deer Flat embankment	do	15,000	.04	.04	.04	8
Truckee-Carson	Dec. 15,1905	Power house, division 6 [f]	do	8,800	.08	.09	.09	10½

TELEPHONE.

Belle Fourche	June 19,1905		Mile	16	$254.50	$300.00	$254.50	0-16
Huntley	Dec. 15,1906		do	22	294.49	304.00	294.49	
Lower Yellowstone	June 1,1905	Division 1	do	35	217.08	242.00	217.08	0-35
Do	do	Division 2	do	35	207.19	239.00	207.19	0-35
Minidoka	June 15,1905		do	18	347.50	366.60	347.50	0-18
Salt River	Sept. 21,1903	Division 1	do	20	278.00	397.19	278.00	
Do	do	Division 2	do	17	295.00	409.00	295.00	
Do	do	Division 3 [i]	do	13	447.00	485.00	447.00	
Do	do	Division 4 [i]	do	16	440.00	475.00	440.00	
Do	Sept. 21,1903	Division 5	do	16	350.00	236.00	350.00	
Strawberry Valley	May 2,1906	Division 1	do	10	251.95	258.00	251.95	[j] 8
Do	do	Division 2	do	28	283.95	325.00	283.95	[j] 19
Do	do	Division 3, apparatus	Complete		100.00	113.80	100.00	
Truckee-Carson		Division 1	Mile	2.791	186.45		(b)	
Do		Division 2	do	6.511	169.18		(b)	
Do		Division 3	do	4.434	130.59		(b)	
Do		Division 4	do	14.32	175.61		(b)	
Do		Division 5	do	13.68	192.29		(b)	
Do		Division 6	do	10.32	236.52		(b)	

[a] Only 1 bid; rejected.
[b] Bids rejected.
[c] Loosely placed.
[d] Cost per mile. Force account.
[e] Concrete reinforcement.
[f] Structural steel in place.
[g] Placing only.
[h] F. O. B. nearest railroad point.
[i] Iron poles.
[j] Average.

Unit prices on contract work—Continued.

TELEPHONE—Continued.

Project.	Date.	Feature.	Unit.	Quantity.	Bids per unit— Lowest.	Bids per unit— Next.	Contract price per unit.	Distance to railroad station.
Uncompahgre Valley	Sept. 22, 1904	Division 1[a]	Mile	9.5	$214.11	$260.00	$214.11	0 -9½
Do	do	Division 2[b]	do	10	214.80	260.00	214.80	7 -9
Do	do	Division 3[c]	do	7.5	242.56	260.00	242.56	7½-15
Do	do	Division 4[d]	do	1	264.50	500.00	264.50	16

TERRA COTTA PIPE.[e]

Project.	Date.	Feature.	Unit.	Quantity.	Bids per unit— Lowest.	Bids per unit— Next.	Contract price per unit.	Distance to railroad station.
Belle Fourche	Oct. 26, 1905	Dam and canals	Foot	[f]1,000	$0.60	$0.70	$0.60	....
Lower Yellowstone	Apr. 12, 1906	Main canal, division 2	do	[g]800	2.50	....	2.50	30
Do	do	Main canal, division 4	do	500	2.50	2.75	2.75	42
Do	June 1, 1905	Main canal, division 1	do	[g]120	2.00	2.00	2.80	18-25
Do	do	Main canal, division 2	do	[g]120	2.00	2.40	2.80	25-34
Do	do	Main canal, division 3	do	[g]110	2.00	2.40	2.80	34-40
Do	do	Main canal, division 4	do	[g]240	2.00	2.60	2.80	40-48 30-38
Do	do	Main canal, division 1	do	[h]120	3.40	3.50	3.50	18-25
Do	do	Main canal, division 2	do	[h]120	3.40	3.50	4.20	25-34
Do	do	Main canal, division 3	do	[h]240	3.50	3.80	4.20	34-40
Do	do	Main canal, division 4	do	[h]360	3.50	4.00	4.20	40-48 30-38
Do	do	Main canal, division 1	do	[i]120	5.10	5.50	5.50	18-25
Do	do	Main canal, division 2	do	[i]360	5.10	5.25	7.00	25-34
Do	June 1, 1905	Main canal, division 3	do	[i]360	5.25	5.50	7.00	34-40 40-48
Do	do	Main canal, division 4	do	[i]360	5.50	5.90	7.00	30-38
Shoshone	May 24, 1906	Garland canal, division 1	do	[h]130	2.00	....	2.00	....
Do	do	Garland canal, division 2	do	[f]100	1.00	....	1.00	....
Umatilla	June 28, 1906	Cold Springs dam	do	[j]1,900	.50	.67	(k)	6
Do	do	do	do	[l]600	1.00	1.35	(k)	6

TUNNELS.

Project.	Date.	Feature.	Unit.	Quantity.	Bids per unit— Lowest.	Bids per unit— Next.	Contract price per unit.	Distance to railroad station.
Huntley	June 28, 1905	Main canal	Linear foot	[m]900	$12.00	$29.00	$29.00	0-17
Do	do	do	do	[n]315	13.00	31.00	31.00	0-17
Do	do	do	do	[o]300	15.50	33.00	33.00	0-17

Do	Jan. 15, 1906	do	do	[m] 1,300	25.00	35.00	35.00		
Do	do	do	do	[n] 500	31.00	48.00			
Do	do	do	do	[o] 740	30.00	42.00			
Klamath	Dec. 29, 1905	Main canal, division 1	do	3,100	25.00	28.50	25.00		
Truckee-Carson	July 15, 1903	Division 2, three tunnels	do	2,600	[m] 36.75	[m] 62.50	[m] 36.75		
					[n] 37.20	[n] 55.00	[n] 37.20		
					[o] 40.00	[o] 40.00	[o] 40.00		
Uncompahgre Valley	Oct. 5, 1904	Gunnison tunnel	do	[p] 11,500	34.14	39.50	34.14	8-16	
Do	do	do	do	[q] 1,200	35.10	41.90	35.10	8-16	
Do	do	do	do	[r] 10,000	26.60	45.50	26.60	8-16	
Do	do	do	do	[s] 3,500	36.60	48.33	36.60	8-16	

WATER FOR PUDDLING.

Shoshone	May 24, 1906	Garland canal, division 1	Gallon	250,000			[t] $0.60	8
Do	do	Garland canal, division 2	do	2,400,000			[t] .60	7
Do	do	Garland canal, division 6	do	1,000,000			[t] .60	7

WELLS (ARTESIAN).

Belle Fourche	May 30, 1905	Reservoir well [u]	Foot	1,391	$1.28		([v])	14
Do	do	Headquarters well [w]	do	627			([v])	2

WIRE FABRIC.

Shoshone	May 24, 1906	Garland canal, division 1	Pound	260	$0.10		([v])	8
Do	do	Garland canal, division 2	do	320	.10		([v])	7
Do	do	Garland canal, division 6	do	40	.10		([v])	7

[a] Along railroad 9½ miles from Montrose.

[b] Along canal, 7-9 miles from Montrose.

[c] 7½-15 miles from Montrose.

[d] East end of tunnel. 16½ miles from Montrose.

[e] The bids on pipes include delivery and placing including joints and refilling trenches.

[f] Size, 12 inches.

[g] Size, 24 inches.

[h] Size, 30 inches.

[i] Size, 36 inches.

[j] Size, 6 inches.

[k] Rejected.

[l] Size, 8 inches.

[m] Material that will stand.

[n] Material requiring temporary lining.

[o] Material requiring permanent lining.

[p] Earth.

[q] Indurated material.

[r] Loose rock.

[s] Solid rock.

[t] Fixed rate per 1,000 gallons.

[u] Size, 2, 3, and 4 inch pipe.

[v] Bids rejected.

[w] Size, 2 and 4 inch pipe.

Contract prices for cement.

Project.	Date.	Cement Co.	Place.	Price at works.	Price at project
Belle Fourche	Apr. 10, 1905	Western Portland Cement Co.	Yankton, S. Dak	$1.10	$2.15
Do	do	Alpena Portland Cement Co	St. Paul, Minn		[a] 3.37
Do	do	Fowler & Pay	Mankato, Minn	.95	2.78
Do	do	Kansas Portland Cement Co	Iola, Kans	1.25	3.07
Do	do	Illinois Steel Co	South Chicago, Ill		[a] 2.32
Do	do	Wabash Portland Cement Co.	Stroh, Ind	1.10	[b] 3.17
Do	do	Portland Cement Co	Portland, Colo	.90	2.42
Do	May 19, 1905	Iola Portland Cement Co	Iola, Kans	1.00	
Do	Feb. 6, 1906	Pacific Portland Cement Co	Tolenas, Cal	1.55	2.43
Hondo	Jan. 10, 1905	Western Cement Selling Co	Denver, Colo		2.83 [c] 2.95
Do	do	Atlas Portland Cement Co	New York City		[d] 3.39
Do	do	Portland Cement Co	Portland, Colo		2.95
Huntley	Aug. 24, 1905	Illinois Steel Co	South Chicago, Ill	1.00	
Do	Sept. 5, 1905	do	do	1.10	
Lower Yellowstone.	July 31, 1905	do	do	1.00	2.82
Do	do	Alpha Portland Cement Co	St. Paul, Minn	1.37	2.89
Do	do	Atlas Portland Cement Co	New York, N. Y		2.97
Minidoka	Aug. 25, 1904	Portland Cement Co	Portland, Colo		3.26
Do	do	Kansas Portland Cement Co	Iola, Kans		3.37
Do	do	Utah Portland Cement Co	Salt Lake, Utah		2.95
Do	do	Atlas Portland Cement Co	New York City		3.71
North Platte	Mar. 16, 1905	Iola Portland Cement Co	Iola, Kans. (92 per cent.)	.90	2.43
Do	do	Kansas Portland Cement Co	do	.90	2.99
Do	do	Portland Cement Co	Portland, Colo	1.10	2.53
Do	do	do	Salt Lake, Utah	1.75	
Do	Nov. 1, 1905	do	Portland (1.40), Denver, Colo.	1.59	2.20
Do	Nov. 13, 1905	do	Portland, Colo	1.40	2.198
Do	do	Illinois Steel Co	South Chicago, Ill	1.30	2.645
Do	do	Western States Cement Co	Jackson, Mich		3.00
Do	do	Sunderland Bros	Omaha, Nebr		3.25
Do	do	Wm. Parr & Co	Galveston, Tex		3.85
Shoshone	Sept. 26, 1905	Illinois Steel Co	South Chicago, Ill	1.30	
Do	do	Portland Cement Co	Portland, Colo	1.35	
Do	do	Alpena Cement Co	St. Paul, Minn	1.40	
Truckee-Carson	July 8, 1903	Standard Portland Cement Co.	Napa Junction, Cal.	1.60	
Do	Sept. 25, 1903	Spreckels Bros. Co	San Francisco, Cal		2.55
Do	do	Cowell Lime and Cement Co			3.50
Do	do	Grace & Co			3.44
Do	Nov. 7, 1903	Spreckels Bros. Co	San Francisco, Cal		2.55
Do	Apr. 3, 1905	Pacific Portland Cement Co	Tolenas, Cal	1.50	
Do	do	Western Fuel Co	San Francisco, Cal	1.70	
Do	July 25, 1905	do	Iola, Kans	1.60	
Do	do	Pacific Portland Cement Co	Tolenas, Cal	1.50	
Do	do	Utah Portland Cement Co	Salt Lake City, Utah.	2.00	
Yuma	Aug. 4, 1905	California Cement Co	Colton, Cal		3.16
Do	Aug. 12, 1905	Portland Cement Co	Tolenas, Cal	1.50	2.76
Do	Sept. 30, 1905	Pacific Portland Cement Co	do	1.55	2.82
Do	do	Western Fuel Co	Napa Junction, Cal.	1.60	2.88
Do	do	Western States Portland Cement Co.	Independence, Kans	1.25	2.96
Do	do	California Portland Cement Co.	Colton, Cal	2.45	3.07

[a] Sacks. [b] Bulk. [c] Ideal. [d] Iola.

ARIZONA.

SALT RIVER PROJECT.

GENERAL STATEMENT.

The principal data relating to the Salt River project are summarized below:

Summary of principal data relating to Salt River project.

Counties: Maricopa, Gila.
Latitude: 33° 30′.
Longitude: 112°.
Townships: 7 north to 2 south, ranges 2 west to 14 east.
Average rainfall: On drainage basin, 10 to 20 inches; on irrigable area, 3 to 10 inches.
Estimated annual discharge of Salt River at dam site: 663,000 acre-feet.
Range of temperature: Maximum, 120°; minimum, 20°; mean, 70°.
Average elevation of irrigated lands: 1,000 to 1,300 feet.
Principal products: Semitropical fruits, cereals, alfalfa.
Principal railroads: Gila Valley, Globe and Northern; Santa Fe, Prescott and Phoenix; Maricopa and Phoenix.
Nearest station: Globe, 43 miles from dam; Phoenix, 78 miles from dam, in center of irrigable district.
Principal markets: Phoenix, Pacific coast cities, and eastern fruit markets.
Irrigable area: 272,000 acres.
Watershed area: 6,260 square miles above the mouth of Verde River.
Reservoir area: 25.5 square miles.
Capacity of reservoir: 1,284,000 acre-feet at elevation 220 feet above low water.
Duty of water: 4 acre-feet per year.
Height of dam: 270 feet.
Length of dam: 235 feet at river, 1,080 feet at top, including spillways.
Type of dam: Masonry arch; gravity section from foundation.
Power developed: 4,400 horsepower (at dam site); penstock tunnel, 620 feet.
Length of tunnels: 9,780 feet.
Ownership of lands: Private.
Character of soil: Sandy loam, with clay in places.
Value of irrigated land: $50 to $500 per acre, depending upon location.

This project contemplates the irrigation of about 200,000 acres of fertile land in the Salt River Valley near Phoenix. This land lies on both sides of the river and slopes gently to the southwest. There is a large district near Mesa and Tempe where the underground water is so near the surface as to be readily reached by pumping, and the installation of enough pumping plants to irrigate from 25,000 to 40,000 acres of land in addition to the area served by the reservoir will soon be under way.

When finally completed the irrigation works will consist of the Roosevelt dam, impounding 1,300,000 acre-feet of water; a large diversion dam at Granite Reef, about 30 miles above Phoenix, to divert the combined waters of the Salt and Verde rivers into the canal systems of the valley; pumping plants, for which power will be generated at the Roosevelt dam and at various points along the canals and Salt River; and a complete system of main and distributing canals and laterals. Part of these works are already finished and in operation.

On account of the great distance of this project from the railroad and centers of population, it was necessary to do considerable preliminary work in order to enable operations to be carried on properly. In order to afford proper means of transporting materials and supplies it was necessary to build a wagon road from Roosevelt to Mesa and from Roosevelt to Tonto, and a logging road from Roosevelt to the sawmill. It was also necessary to erect proper office buildings and cottages for the engineering force, warehouses for the supplies and equipment, and corrals and stables for the animals. A system for providing a water supply has been installed and a refrigerating plant has been erected. Other structures that have been necessary for the proper prosecution of the work include a telephone line, sawmill, cement mill, rock-crushing plant, machine and blacksmith shops, and a power plant, comprising canal, dam, electric machinery and penstock tunnel. The greater part of these structures were built prior to the period covered by this report and are described in previous annual reports. Additional details concerning those on which work has been carried on during the last year are given below. A general view of the works at Roosevelt is given in Pl. I.

In the following table are listed the contracts entered into for building work on the Salt River project. This list includes all contracts for excavation, embankment, masonry, and erection of structures, but does not include materials such as cement, steel, timber, etc.:

Contracts for building work on Salt River project to June 30, 1906.

No. of contract.	Contractor.	Feature.	Estimated total value.[a]	Payments to June 30, 1906.	Per cent paid.
5	Wilcox & Rose	Cement mill	$12,088.00	$12,505.56	100
7	James R. Thorpe	Telephone	22,348.00	22,711.43	100
11	Robert Sherer & Co.	Power canal, sch. 1	165,400.00	317,681.50	100
12	John Tuttle	Power canal, sch. 2	140,912.00	166.623.66	100
13	.....do	Sluicing tunnel	12,000.00	11,178.00	100
35	J. M. O'Rourke & Co	Roosevelt dam	1,147,600.00	31,065.59	3

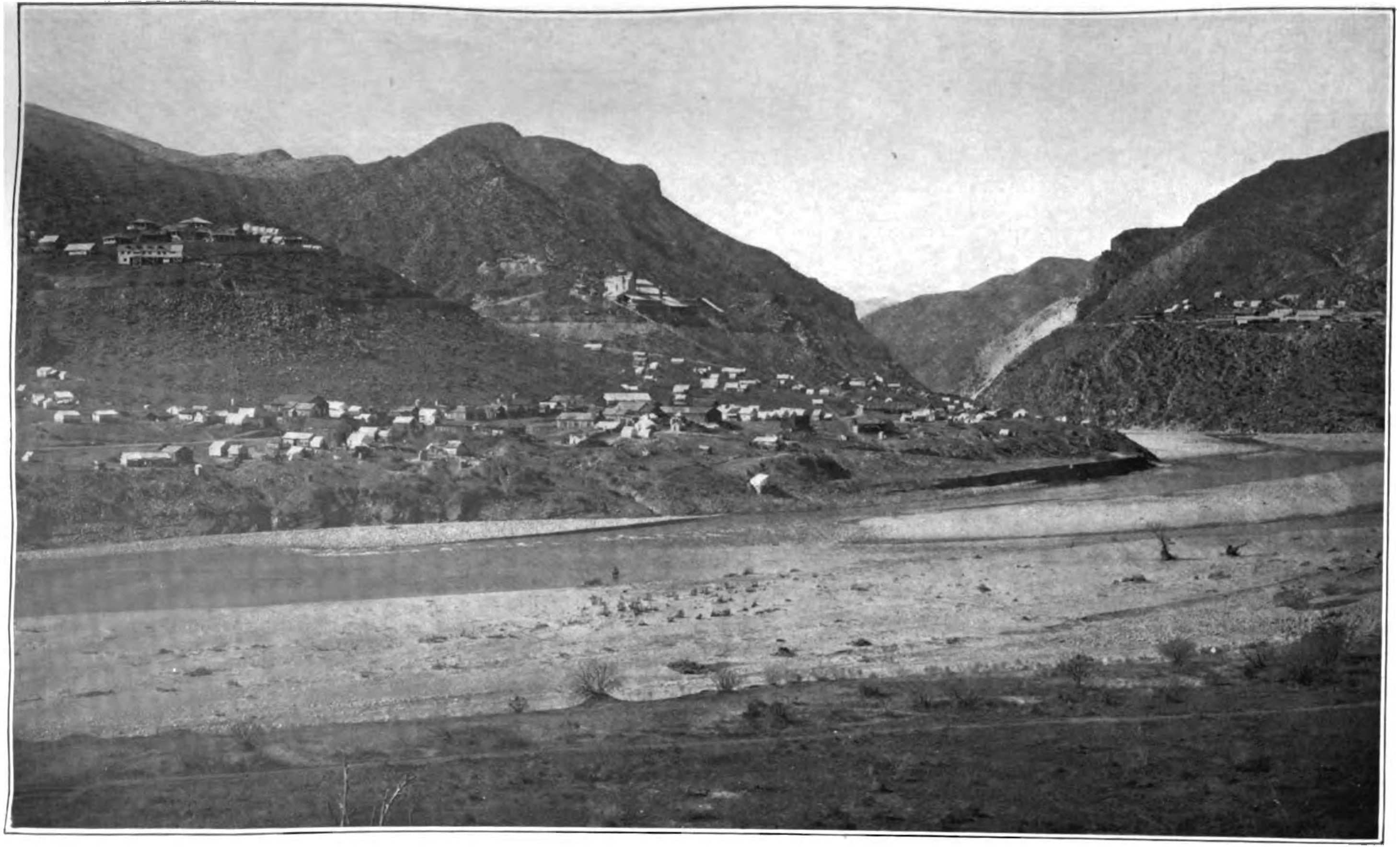
[a] For a discussion of advance estimates and final costs see page 51.

ROOSEVELT DAM.

The general description of this dam and bids for building it are given in the Third and Fourth Annual Reports. Since these reports were published the proposed height of the dam has been increased 10 feet, thereby increasing the capacity of the reservoir to 1,300,000 acre-feet, or nearly 20 per cent. This addition to the height of the dam will increase the total quantity of masonry to 340,000 cubic yards, an increase of but 13 per cent.

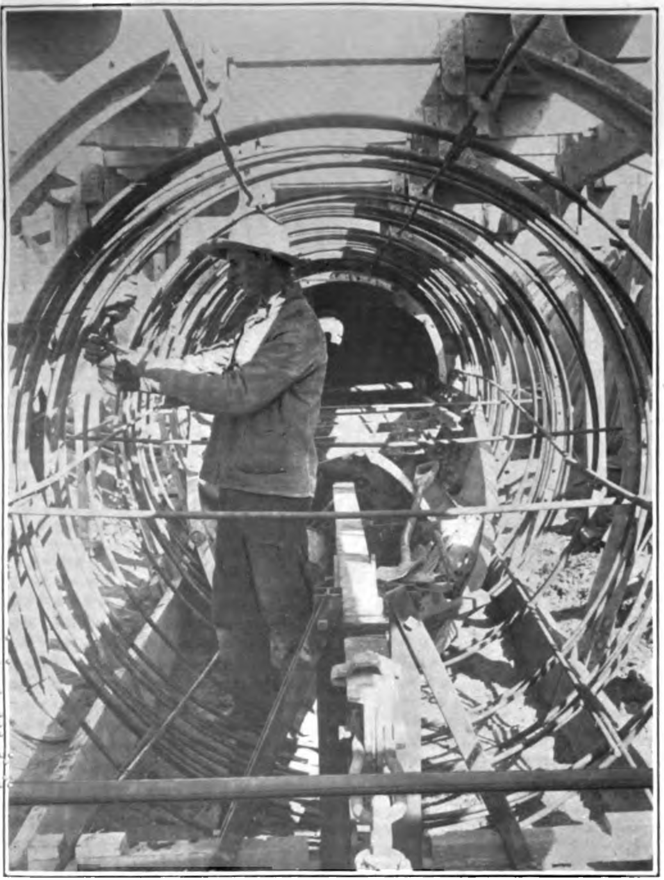
A Leschen aerial tramway, 1,700 feet long, has been installed for the purpose of taking the cement from the mill and delivering it at the contractor's stone crusher and concrete mixing plant, near the south end of the dam. This tramway will also handle the sand, which is to be crushed limestone from the quarry and crushing plant operated by the United States midway between the cement mill and the dam.

In November, 1905, after the contractors had done considerable work on the temporary dams and flume, there occurred the largest flood on Salt River since 1891, the river rising about 25 feet in one

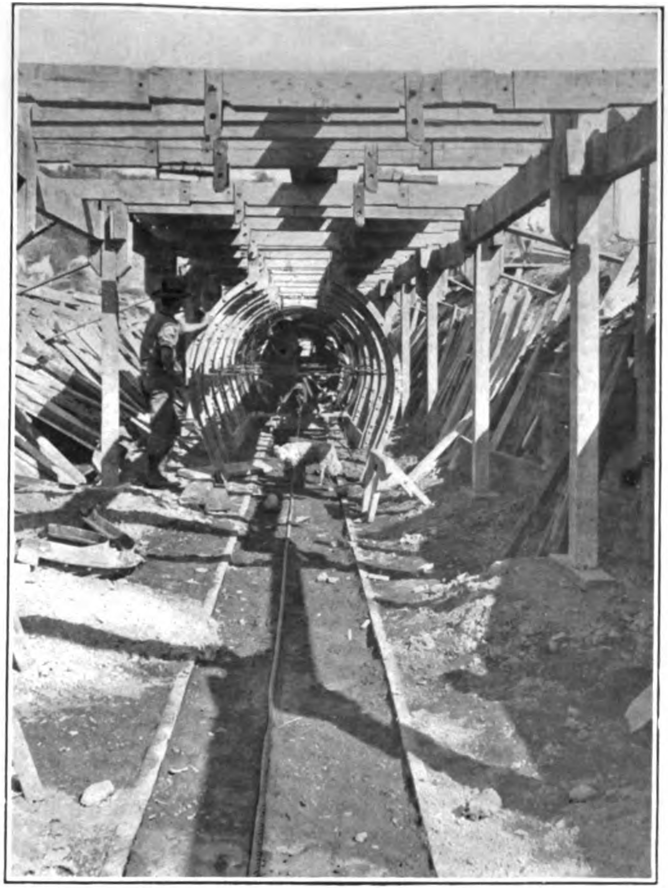


ROOSEVELT, ARIZ., LOOKING DOWN THE SALT RIVER FROM WITHIN THE RESERVOIR SITE, SALT RIVER PROJECT, ARIZONA, MARCH 6, 1906.

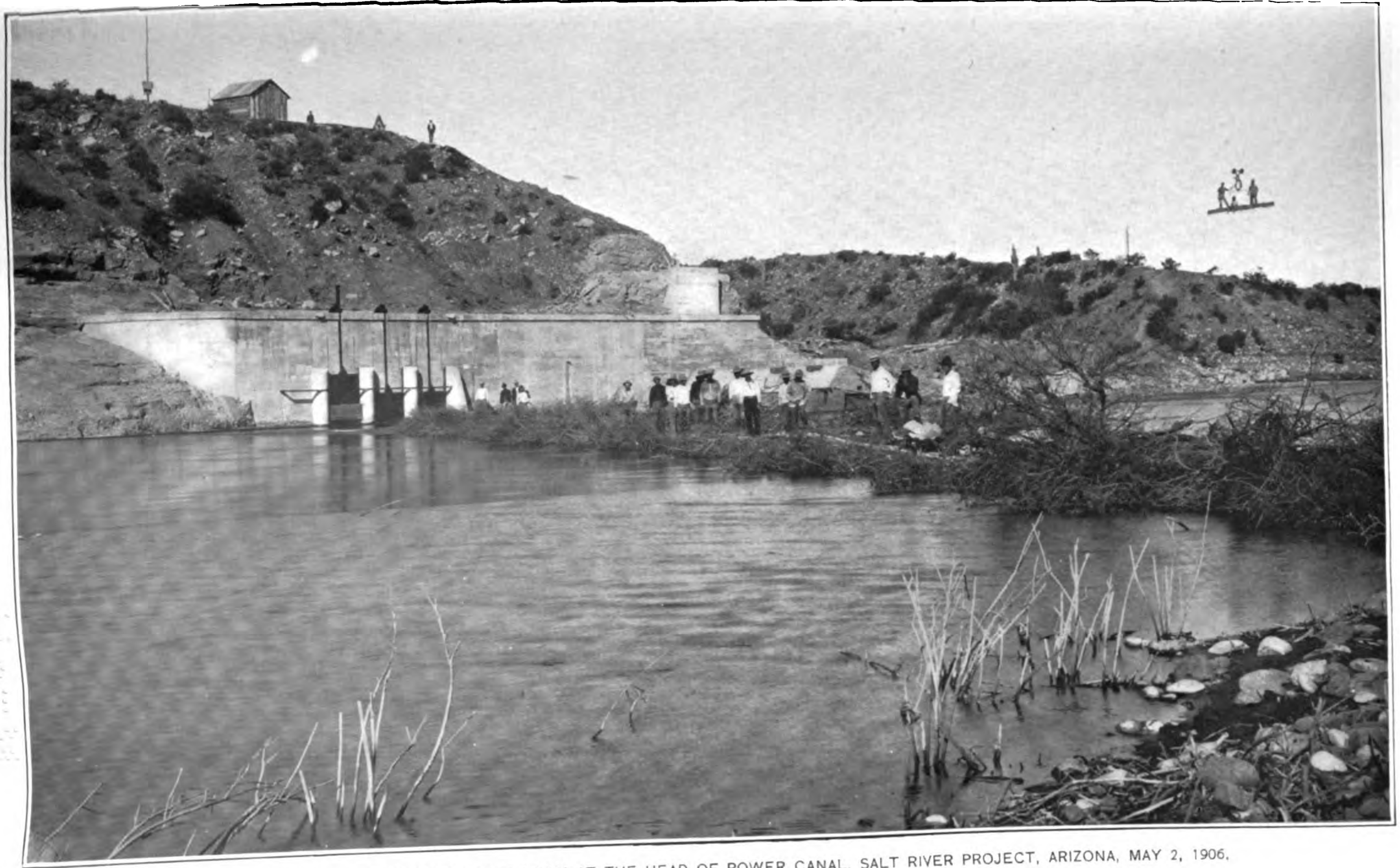
U. S. Reclamation Service headquarters on the hill to left; main street of Roosevelt along the low ground; cement mill on hillside in center; dam site just within canyon; contractors' camp on hillside to the right.



A. FORMS AND REENFORCING FOR PINTO REENFORCED CONCRETE PRESSURE PIPE ON POWER CANAL, SALT RIVER PROJECT, ARIZONA.



B. HANGERS FOR OUTSIDE FORMS FOR PINTO REENFORCED CONCRETE PRESSURE PIPE ON POWER CANAL, SALT RIVER PROJECT, ARIZONA.



INTAKE WORKS AND TEMPORARY BRUSH DAM AT THE HEAD OF POWER CANAL, SALT RIVER PROJECT, ARIZONA, MAY 2, 1906.

night. In consequence, all the work was destroyed and the contractors suffered some loss of machinery and tools. During the winter the river continued so high that no work could be done in the bottom, and the contractors turned their attention to completing the installation of their plant, to preparing the quarries on both sides of the river, and to excavating the rock wall on the south side of the river for the foundation of the dam. In April, 1906, work in the bottom was resumed, and on June 13 the temporary works were so near completion that the river was diverted through the sluicing tunnel.

For the purpose of excavating the sand and gravel in the river bed, the contractors installed two 11-inch hydraulic gravel elevators, with giants to wash the material to them. As auxiliaries and for the purpose of keeping the pit free from water they also installed four hydraulic water lifts. The water to operate the entire hydraulic installation is furnished from the power canal under a head, in the bottom of the pit, of about 250 feet.

Considerable sand and gravel have been excavated, and the sump is now only about 8 feet above bed rock. It is hoped that before winter sufficient masonry will have been put in along the upstream face of the permanent dam to protect the remainder of the site, and to permit of work on the masonry through at least a large part of the winter. A general view of the dam is given on Pl. II.

OUTLET TUNNEL AND GATES.

A tunnel about 500 feet long through the side walls of the canyon at the dam will serve as an outlet to the reservoir and will also afford means of removing the accumulated silt. In this tunnel will be placed six gates to regulate the flow of the water. These gates with their operating mechanism will weigh nearly 800,000 pounds, and will be the largest ever constructed to operate under the great pressure of 100 pounds per square inch. The tunnel is already completed and some of the gates have been delivered.

POWER CANAL.

The power canal, which is about 20 miles long, was finally completed by the contractors during the latter part of 1905 and was put in operation early in the spring of 1906. The flood of November, 1905, changed the course of the river over half a mile, destroyed one farm, and threatened a portion of the canal. As the river continued to encroach on the threatened portion, a cut-off canal was built through the hills around the dangerous part, and, when completed, the water was diverted around the cut-off with but a few hours' shut down of the power plant. The power house has been in operation since March, and since June has run twenty-four hours a day, except for a few hours once a week. The second line of reenforced concrete pipe (Pls. III and IV), which carries the canal under two wide gulches, was finally completed about the end of July, 1906.

DIVERSION DAM FOR POWER CANAL.

A weir to divert the water into the power canal is being built by force account (Pls. V and VI). A temporary brush dam that has served to turn enough water into the power canal for present use is being used as a cofferdam during the erection of the permanent structure. The intake gates and the sluicing gates on the south side and the dike and wing walls on the north side, besides 150 feet of the 400 feet of the dam, are completed, and work is being rushed as rapidly as possible.

POWER PLANT.

The first consignment of machinery for the permanent power plant has been received. This unit will not be placed in position for some time in order that J. M. O'Rourke & Co. may have every opportunity to get the dam above water. Up to the present time the 1,300 horsepower unit already installed has proved amply able to supply all needs, but as soon as the dam is above water, both wheels will probably be required. This winter a transmission line will be built to the valley below and the surplus power be utilized there for pumping and other purposes.

SAND-CRUSHING PLANT.

The building for this plant was completed, the machinery set up, and the quarry opened early in 1906, but, with the exception of a few days' trial run, the mill has been shut down as the contractor for the dam is not ready to lay stone.

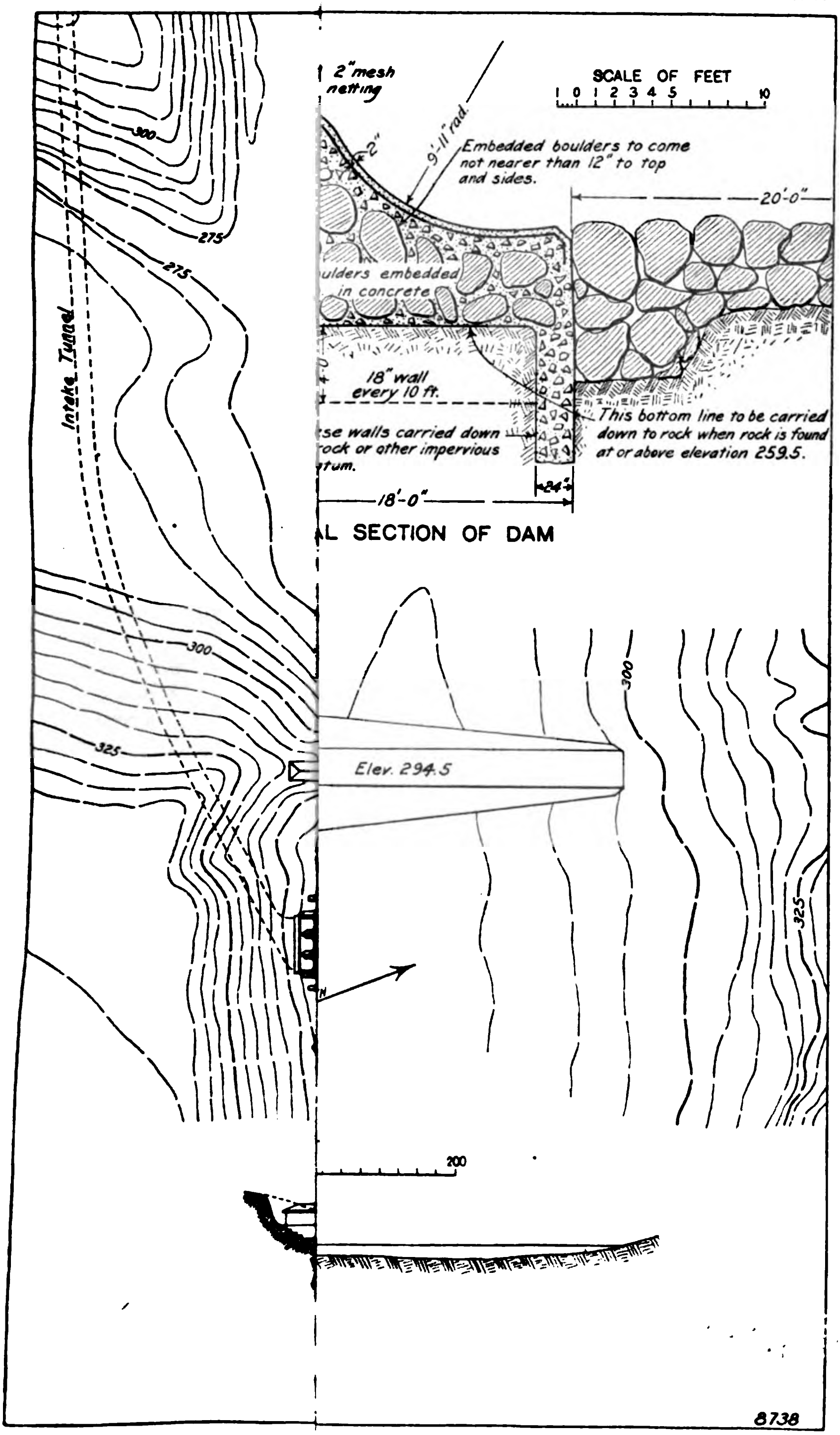
CEMENT MILL.

In estimating the cost of building the Roosevelt dam it became necessary to obtain from manufacturers prices on the delivery of about 200,000 barrels of cement at Globe, then the nearest railroad point. Early bids and estimates from the manufacturers show that the cement delivered would cost approximately $9 per barrel. At that time it seemed as though there would be no chance of having this price materially reduced.

A careful examination of the country adjacent to the dam site showed a large deposit of high-grade limestone. Preliminary estimates of the cost of a cement mill with an output sufficient to meet the needs of the contractor during the construction of the dam and of the cost of manufacturing showed a large saving compared with the cost of cement purchased and hauled to the dam. Accordingly specifications were drawn and bids asked for building a cement mill near the present town of Roosevelt.

As some manufacturers claimed that they were able to furnish cement at a much lower price than the United States was able to manufacture it, bids were asked for the delivery of 150,000 barrels of cement at the dam site. The lowest price obtained was $4.98 a barrel. As this price was much higher than the cost of manufacturing, plus the cost of the mill, as estimated by the Government engineers, the bid was rejected. This bid was based on a wagon-freight rate of $8 per ton from Globe to the dam site, a rate $2 per ton, or approximately 40 cents per barrel, less than the prevailing one. Cement at that time was selling at the works for $1.10 a barrel, to-day at the same points it is selling for from $2 to $2.10 a barrel.

The entire cost of building the cement mill up to June 30, 1906, was $218,380.57, which includes all cost of excavation, foundations, building, machinery, erection, and every charge usually made under the heading of betterment of plant.


2" mesh netting
SCALE OF FEET
0 1 2 3 4 5 10
9'-11" rad.
2"
Embedded boulders to come not nearer than 12" to top and sides.
20'-0"
ulders embedded in concrete
18" wall every 10 ft.
se walls carried down rock or other impervious tum.
This bottom line to be carried down to rock when rock is found at or above elevation 259.5.
18'-0"
24"
L SECTION OF DAM
300
275
275
Intake Tunnel
300
325
Elev. 294.5
300
325
200
8738

ONA.

The cost of manufacturing cement in April and May, 1906, was as follows:

Cost of cement per barrel during April and May, 1906.

	April.	May.		April.	May.
Office salaries	$0.13	$0.10	Fuel wood	....	$0.03
Operating labor	.35	.28	Handling wood	$0.001	....
Maintenance:			Miscellaneous labor and material	.02	.02
Labor	.22	.12	Electric power	.14	.16
Material	.11	.08	Fuel oil	1.00	1.00
Quarry labor	.13	.20			
Quarry explosives	.104	.01	Total	2.24	2.08
Clay digging	.035	.02			
Clay hauling	.09	.06	Total output in barrels	....	6,522

As the capacity of the mill is about 350 barrels a day or 10,000 barrels a month, the above cost will be materially reduced when the mill is operating continuously as the fixed charges per month will be divided by 10,000 instead of by 6,522.

There is also included in the above estimate of the cost of operation of the cement mill a charge of $0.14 in April and $0.16 in May per barrel for power. Under the contract with J. M. O'Rourke & Co., the Government furnishes them power from its power plant at a fixed price. The power used by the cement mill is charged at the same price although the cost to the United States is the same, whether the cement mill requires it or not. The actual expense to the United States, therefore, for the production of cement should be $2.10 for April and $1.92 per barrel for May.

Since starting the mill, negotiations have been entered into by the United States for the purchase of the canal systems on the north side of the river near Phœnix, and work has been begun on the building of a large diversion dam, on which will be used from 40,000 to 60,000 barrels of cement. A careful estimate of the cost of delivering the cement from the mill at Roosevelt to the dam site, compared with the cost of purchasing in the market, delivery at Mesa by railroad and hauling by wagon 12 miles to the dam shows that it is cheaper to manufacture the cement at Roosevelt and haul it 60 miles as back freight than to buy it in the open market.

TELEPHONE LINE.

On December 26, 1903, a contract was entered into with James R. Thorpe, of Denver, Colo., for installing a telephone line between the head of the power canal and the Arizona dam, 25 miles from Phoenix. Later this line was extended by force account into Phoenix and Mesa, and the local service was greatly improved. At Phoenix the line connects with the Consolidated Telephone Company's system, and through it with the principal towns in the Territory. The line will ultimately connect with all the pumping plants in the valley, and will be invaluable in the future operations of the whole irrigation system of the Salt River Valley.

ARIZONA CANAL SYSTEM.

The failure of the Arizona dam, the principal diversion weir for the canals on the north side of the river, during the great floods of 1905, caused great loss to all the farmers having lands under it. Negotiations were entered into for the purchase by the United States of the entire north-side canal system. A board of engineers was appointed by the Secretary of the Interior to appraise the property of the Arizona Water Company and of the Maricopa, the Salt, and the Grand companies.

On February 17, 1906, a contract was made for the purchase of the Arizona main canal system and the appurtenances for $235,168; and for the purchase of the Arizona Cross Cut canal, the Grand canal, the joint head of the Maricopa and Salt River Valley canals, the Maricopa canal, and the Salt River Valley canal and the appurtenances thereof, for the sum of $78,993. This contract was approved by the Secretary of the Interior on March 7, 1906.

As a result of this purchase the United States will control substantially all the canal systems on the north side of Salt River, and will be in a position to provide for the distribution of all the water for irrigation on that side of the river under one general system.

There is now pending in the Territorial supreme court an action for the determination of all rights to the use of the waters of Salt River and its tributaries. The adjustment of these rights, either by means of these proceedings or otherwise, is an essential preliminary to the operations of the Reclamation Service under this project.

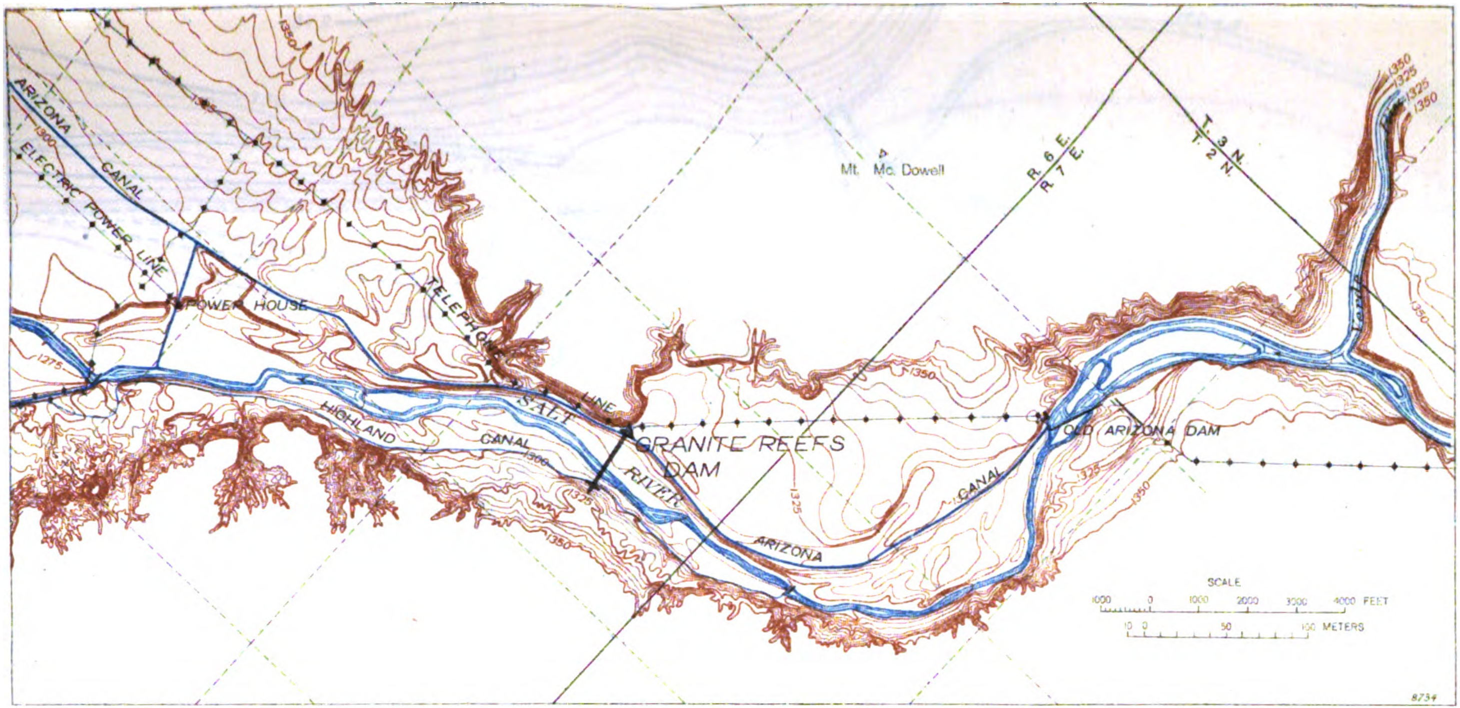
The adjustment of these rights in connection with the purchase of the canal systems on the north side of the river will provide for a system of distribution that will enable all those who are entitled to the use of the water of the river to obtain the amount to which they are entitled with much less friction than has heretofore been experienced. There will undoubtedly be in addition a considerable saving of water by reason of a comprehensive system of distribution.

GRANITE REEF DAM.

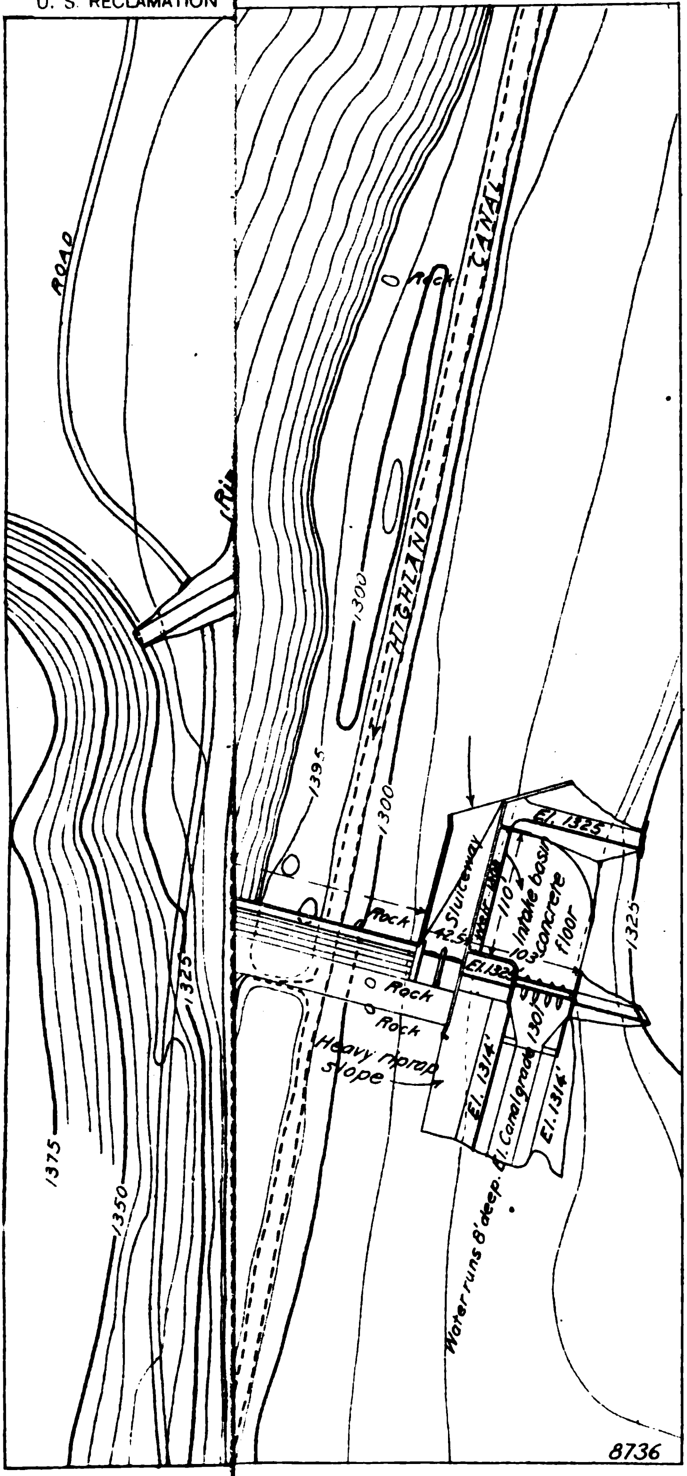
Borings for a new diversion dam (Pls. VII–XI), to be located about 2 miles below the old Arizona dam, were completed in June, and its erection by force account was authorized on July 26, 1906. This weir will raise the water of the combined Salt and Verde rivers about 15 feet. It will be nearly 1,300 feet long and will contain, including the masonry for the sluice and regulating gates, about 40,000 yards of concrete. The regulating gates and the main distributing canal on the north side will have a capacity of 2,000 second-feet, and the gates and canals on the south side will have a capacity of about 1,000 second-feet. This dam will ultimately divert all the water used on both sides of the river and will save the heavy maintenance charges of the six temporary structures now used. It is of even greater immediate importance to the welfare of the Salt River Valley than the Roosevelt dam. Work has already been started and will be pushed during the winter.

IRRIGABLE LANDS.

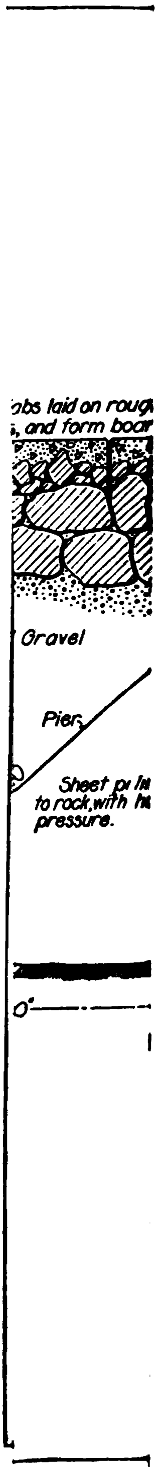
The irrigable lands lie on both sides of Salt River in the neighborhood of Phoenix. The soil is a sandy loam and the value of the lands ranges from $50 to $500 per acre, according to location. The principal crops are semitropical fruit, cereals, and alfalfa. The distribution of the lands under this project is shown in the following table:



GENERAL MAP SHOWING LOCATION OF THE GRANITE REEFS DIVERSION DAM AND NEW HEADWORKS FOR THE ARIZONA CANAL
SALT RIVER PROJECT ARIZONA

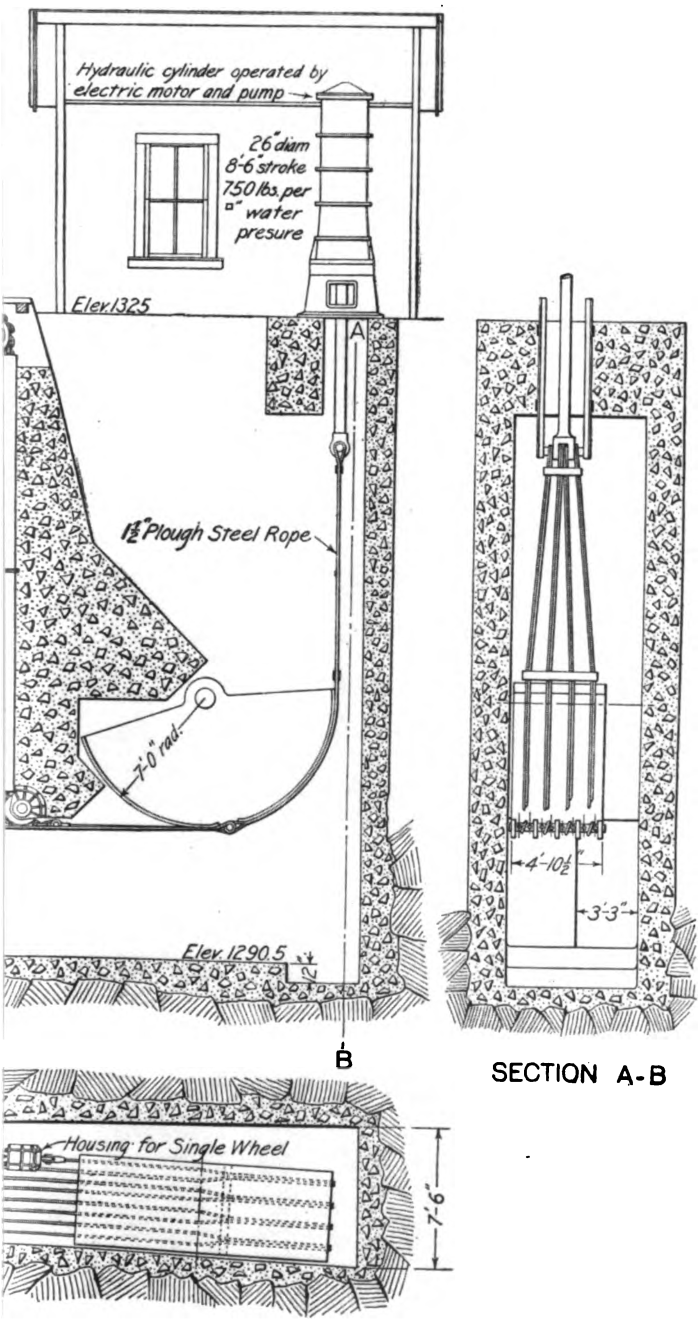

ROAD
Rio
Rock
HIGHLAND CANAL
1300
1395
1300
Rock
Sluiceway
42.5
Weir
110
Intake basin
103 concrete floor
El. 1325
El. 1325
1325
El. 1324
Rock
Rock
Heavy riprap slope
1301
El. 1314'
El. Canal grade
El. 1314'
Water runs 8' deep.
1325
1375
1350
8736

NA CANAL


abs laid on roug
, and form boar
Gravel
Pier
Sheet pi
to rock, with h
pressure.
0'

A CANAL,

MnU


Hydraulic cylinder operated by electric motor and pump
26" diam
8'-6" stroke
750 lbs. per □" water presure
Elev. 1325
A
1½" Plough Steel Rope
7'-0" rad.
Elev. 1290.5
12"
B
4'-10½"
3'-3"
SECTION A-B
Housing for Single Wheel
7'-6"

8782

RIZONA.

M 10 U

Lands included in Salt River project.

	Culti-vated.	Unculti-vated.	Culti-vated.	Unculti-vated.
GENERAL SUMMARY.	*Acres.*	*Acres.*	*Per cent.*	*Per cent.*
North of river	73,145	94,120	26	35
South of river	51,947	53,604	19	19
Total	125,092	147,724	46	54
NORTH OF RIVER.				
Under Arizona canal	23,440	73,341	24	76
Under Grand canal	19,871	12,038	63	37
Under Maricopa canal	14,186	295	98	2
Under Salt canal	15,648	8,446	65	35
SOUTH OF RIVER.				
Under Highland canal	540	14,530	3	97
Under Consolidated canal	1,320	27,440	4	96
Under Mesa canal	13,657	3,095	81	19
Under Utah canal	9,600	958	91	9
Under Tempe canal	21,000	5,084	80	20
Under San Francisco canal	4,328	332	93	7
Under French, Lambeye, and other canals	1,502	2,165	40	60

EXPENDITURES.

The expenditures to June 30, 1906, are summarized in the following tables:

Expenditures, according to physical features, on Salt River project to June 30, 1906.

Features.	Engineering and administration.	Building.
Incidental structures:		
Road, Mesa to Roosevelt, 62 miles	$4,300.00	$286,242.47
Road, Mesa to Roosevelt, flood expenditure	....	18,585.52
Road, Livingstone to sawmill, 22 miles	680.00	14,150.00
Road, Roosevelt to Tonto, one-half mile	338.40	6,680.04
Road, Desert wells to Arizona dam, 8 miles	175.00	1,549.13
Road, Roosevelt to Globe, 15 miles	565.00	26,653.88
Road, miscellaneous, 27½ miles	230.00	8,605.83
Suspension bridge	....	772.19
Telephone line	981.00	48,123.07
Steam power plant and electric lighting	792.00	38,440.54
Cement mill	3,241.00	218,839.61
Sawmill	....	8,111.31
Rock-crushing plant	540.00	19,911.40
Machine and blacksmith shop	114.00	7,092.00
Waterworks	320.00	12,635.91
Refrigerating plant	100.00	5,069.82
Headquarters buildings, offices, etc	1,000.00	23,677.86
Headquarters cottages, boarding houses	560.00	29,510.58
Headquarters warehouses, corrals, etc	128.00	2,953.20
Inventory, undistributed	....	80,104.52
Irrigation structures:		
Power diversion dam	1,750.00	41,530.87
Power canal	29,069.65	790,040.56
Power canal pressure pipe and structures	2,000.00	140,101.69
Penstock tunnel	878.00	62,023.68
Water and electric power plant	1,864.00	45,851.86
Roosevelt reservoir, lands submerged	....	104,464.89
Roosevelt dam and spillway	13,966.00	116,684.36
Roosevelt dam gates	2,978.00	89,339.12
Roosevelt dam sluicing tunnel	940.00	44,578.60
Arizona dam	8,406.23	....
Arizona canal	3,170.42	....
Irrigable lands: Farm units subdivision and soil examination	15,283.86	....
Examination of project as a whole	110,961.41	....
Administration of the project as a whole	180,714.29	....
Total	386,046.26	2,292,324.51
Grand total	....	2,678,370.77

Expenditures, according to purpose and nature, on Salt River project to June 30, 1906.

[Total, $2,678,370.77.]

	Services.	Traveling.	Subsistence.	Equipment.	Materials.	Supplies.	Rent and storage.	Forage.	Job work.
Engineering:									
Examination......	$25,898.12	$3,206.88	$5,350.29	$1,791.84	$2,697.37	$2,648.75	$135.30	$1,307.86	....
Survey and inspection......	60,941.66	6,846.45	7,864.61	17,256.41	3,400.00	6,761.53	522.51	5,392.67	....
Design.....	29,841.49	1,287.07	3,648.30	4,151.86	3,420.50	4,824.89	226.75	963.85	....
Subdivision	3,487.77	305.56	7.55	436.51	....	535.02	87.30	1.80	....
Building:									
Rights and property.	1,139.33	265.60	114.36	.75	....	95,167.20	....	....	....
Building...	828,413.54	4,205.81	147,800.90	101,048.67	137,328.00	206,818.13	4,516.89	59,510.35	$705,994.98
Maintenance.	....	....	....	37.50	46.00	....	....	....	....
Administration........	113,369.49	16,184.13	7,160.58	14,602.82	5,532.37	19,546.84	2,010.23	2,307.83	....

PROPOSED SAN PEDRO PROJECT.

The only work done on the San Pedro project during the last fiscal year was in connection with the measurements of the flow of San Pedro River.

A summary of the total expenditures on this proposed project is given in the following table:

Expenditures, according to purpose and nature, on proposed San Pedro project to June 30, 1906.

[Total, $2,341.62.]

	Services.	Traveling.	Subsistence.	Equipment.	Materials.	Supplies.	Forage.
Engineering:							
Examination....	$1,078.06	$87.00	$280.89	$173.86	$5.50	$146.77	$57.46
Survey...........	240.93	21.10	....	....	....	....	....
Administration......	120.47	58.10	31.20	17.73	....	16.17	6.38

PROPOSED SAN CARLOS PROJECT.

Two gaging stations have been maintained on this project, one on San Francisco River and one on Gila River, but no other work has been done during the last fiscal year. A summary of the total expenditures is given in the following table:

Expenditures, according to purpose and nature, on proposed San Carlos project to June 30, 1906.

[Total, $22,126.61.]

	Services.	Traveling.	Subsistence.	Equipment.	Materials.	Supplies.	Forage.
Engineering:							
Examination....	$8,521.79	$429.70	$3,777.32	$2,115.94	$294.19	$2,013.10	$758.30
Survey...........	1,872.24	79.24	....	....	....	55.55	....
Subdivision......	36.00	....	....	....	....	....	....
Administration......	1,186.78	39.62	409.82	232.85	....	220.30	83.87

PROPOSED LITTLE COLORADO PROJECT.

No work has been done on this project during the last fiscal year, except that necessary for measuring the flow of Little Colorado River.

A summary of the total expenditures is given in the following table:

Expenditures, according to purpose and nature, on proposed Little Colorado project to June 30, 1906.

[Total, $5,316.81.]

	Services.	Traveling.	Subsistence.	Equipment.	Materials.	Supplies.	Forage.
Engineering:							
Examination....	$2,348.85	$940.68	$355.79	$326.66	$277.93	$202.88	$111.47
Survey...........	200.13	43.12	....	....	....	....	....
Administration......	327.85	144.60	16.22	9.21	....	8.11	3.31

CALIFORNIA.[a]

SACRAMENTO VALLEY INVESTIGATIONS.

Investigations in Sacramento Valley include a general study of the water supply and the location and survey of available reservoir sites.

DESCRIPTION OF SACRAMENTO VALLEY.

The total area of the Sacramento basin is 26,187 square miles. Sacramento Valley proper contains 4,196 square miles, or, excluding the area of surfaces of perennial streams, about 2,660,000 acres. The elevation of the valley at Red Bluff is about 300 feet. From this point the fall toward the south for 60 miles averages less than 3 feet to the mile. The slope in this direction gradually decreases until it is less than 0.3 of a foot per mile near Sacramento. From the base of the foothills on the east and west, the slope is uniform toward the trough of the valley. Below the mouth of Stony Creek the Sacramento Valley is a typical flood plain, the river banks being from 5 to 20 feet higher than the trough of the valley on either side of the channel. The capacity of the Sacramento River channel below the mouth of Stony Creek to Knights Ferry is less than above Stony Creek. At some points its capacity is said to be less than one-third of that required to pass the flood reaching the valley. The basins on either side of the river are connected with it by sloughs or crevasses, and during ordinary and high stages receive water through them.

The most northerly depression on the west side of the river is the Colusa basin. It is nearly 50 miles long and from 2 to 7 miles wide, and has a storage capacity of approximately 690,000 acre-feet at ordinary stages.

The depression on the west side of the river below Colusa basin and separated from it by the Knights Ferry ridge is called the Yolo basin. It is the largest flood basin, and has a length of 40 miles and an average width of 7 miles. At times of flood it contains about 1,150,000 acre-feet of water. The waters of Cache and Puta creeks are discharged into this basin.

The depressions on the east side of the river, named from north to south, are Butte, Sutter, and American basins. During times of great flood they have a water surface of 400 square miles and hold approximately 1,900,000 acre-feet of water.

The total approximate storage capacity of all the flood basins is 3,800,000 acre-feet, not including the main Sacramento basin. This last basin has been reclaimed by levees for a number of years, though it was flooded in 1904 by a break in the levee. The flood of 1904 was unusually large, though a study of the rainfall record indicates that larger floods have occurred. Portions of the flood basins are never free from water, but a large percentage of the area is used for pasturage. There are localities in the Sacramento Valley where the soil is poor, but taken as a whole the soil may be said to be fertile. The portions of the delta islands and flood basins that have been reclaimed are of unsurpassed fertility. The greater part of the Sacramento Valley has been utilized since it was first settled for the production of wheat and barley. Some portions have been used for this purpose since 1850. Formerly large crops were grown. The amount produced per acre and the quality of the grain has decreased until wheat growing is no longer profitable. Rotation of crops is necessary in order to restore the productiveness of the soil in the wheat-growing districts and to make farming in this valley a certain and substantial industry. This, however, is impossible without irrigation.

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[a] Additional information relating to operations in California is given on pages 100-105 and 255-264.

WORK ACCOMPLISHED.

The surveys and investigations are not sufficiently advanced to determine definitely what percentage of the 2,660,000 acres of land in the Sacramento Valley is adapted to irrigation, but it is known that the area is large, and that it probably exceeds 2,000,000 acres.

During the years of mean rainfall, sufficient water is discharged from the drainage basin to cover the valley to a depth of about 9 feet. The greater part of this water is discharged during the winter or early spring, when it is not needed for irrigation. A study of the stream-flow data indicates the necessity of storing a portion of the winter flow. The proposed storage reservoirs will serve the double purpose of supplying water for irrigation during the irrigation season, when the natural flow of the stream is at its minimum, and decreasing the size of the distributive flood waves in winter and spring.

The following reservoir sites have been surveyed: Guenoc and Monticello, on Puta Creek; Clear Lake and Little Indian Valley, on Cache Creek; Briscoe, East Park, and Mill site, on Stony Creek; Iron Canyon, on Sacramento River; Jess Valley and West Valley, on South Fork Pit River; Warm Spring Valley and Big Valley, on Pit River; Round Valley, on Ash Creek; Big Meadows, on North Fork of Feather River; Indian Valley, on Indian Creek; Upper Mohawk, on Middle Fork of Feather River; and Grizzly Valley, on Grizzly Creek.

Topographic maps of the following reservoir sites have been obtained from Mr. William Watson, C. E., and the city engineer of San Francisco: American Valley, Spanish Ranch Valley, Bucks Valley, Oregon House Valley, and Greenwood.

Summary of data concerning these reservoir sites is as follows:

Capacity of reservoirs surveyed in Sacramento basin.

Name of reservoir.	Description.	Capacity of reservoir basin as surveyed.	Probable amount available annually from watershed.
		Acre-feet.	*Acre-feet.*
Guenoc	100-foot loose rock-fill dam with wasteway	188,000	80,000
Monticello	Greatest depth of water 150 feet (proper height of dam not yet determined).	130,000	130,000
Clear Lake	16-foot dam (outlet channel)	100,000	100,000
Little Indian Valley	130-foot concrete overflow dam	76,500	50,000
Briscoe	125-foot concrete gravity dam with wasteway	14,385	14,385
East Park	115-foot concrete gravity dam with wasteway	26,000	26,000
Mill Site	95-foot loose rock-fill dam with wasteway	43,735	43,735
Iron Canyon	150-foot rubble concrete dam with wasteway	226,900	226,900

Capacity of reservoirs surveyed in Sacramento basin—Continued.

Name of reservoir.	Description.	Capacity of reservoir basin as surveyed.	Probable amount available annually from watershed.
		Acre-feet.	*Acre-feet.*
Jess Valley	60-foot loose rock-fill dam with wasteway	224,560	
West Valley	70-foot loose rock-fill dam with wasteway	94,579	
Warm Spring Valley	.....do	559,015	
Big Valley [a]	100-foot concrete overflow dam	3,196,188	[b] 1,000,400
Round Valley	70-foot loose rock-fill dam with wasteway	184,732	
Big Meadows	North Fork, Feather River	780,384	780,380
Indian Valley	Greatest depth of water, 110 feet	688,000	500,000
Concow	North Fork, Feather River	10,012	10,012
Butte	.....do	107,000	107,000
American Valley	.....do	86,055	86,055
Spanish Ranch Valley	.....do	8,469	8,469
Buck Valley	.....do	37,843	37,843
Grizzly Valley	Middle Fork, Feather River	61,820	20,000
Mohawk Valley	.....do	12,626	12,626
Oregon House Valley	North Fork, Yuba River	90,823	90,823
Greenwood	American River	65,952	65,952
Total		7,013,578	3,390,184

[a] Big Valley reservoir site is below Jess Valley, West Valley, Warm Spring Valley, and Round Valley reservoir sites.

[b] This estimate includes discharge from Goose Lake drainage.

The Geological Survey is making a detailed topographic map of the Sacramento Valley. The mapping of the west side of the valley will be completed in 1906. This map will be used in making a study of the division of the project into units.

The investigation has reached a point where it is necessary to consider the division of the project into relatively small units, and to determine the proper sequence of their construction. This study was commenced in March, 1906, by the consideration of the Red Bluff-Orlands unit. There are 352,000 acres of valley land on the west side of the Sacramento Valley between Red Bluff and the line of the Central Irrigation Canal. This area can be irrigated by the construction of the Iron Canyon and Stony Creek reservoirs. To accomplish this it would be necessary to take out the main supply canal from the Iron Canyon reservoir at an elevation of about 330 feet. It is possible to still further divide the unit by the construction of the Stony Creek reservoirs. Between 40,000 and 50,000 acres of land in the vicinity of Orland could be irrigated from this source. The cost per acre for this small unit would be considerably more than for the larger unit.

Without any encouragement from the officers of the Reclamation Service, a water users' association has been formed at Orland and the land owners of 40,000 acres have signed agreements indicating their willingness to comply with the requirements of the reclamation act. The association in May, 1906, petitioned the Secretary of the Interior to construct an irrigation project to irrigate 40,000 to 50,000 acres of land in the vicinity of Orland. This petition was presented by a representative of the Sacramento Development Association, an organization composed of representatives from each of the counties in the Sacramento Valley and supported by the county governments. This association is endeavoring to hasten the development of the Sacramento Valley, through irrigation, immigration, and other means.

RELATION OF THE STORAGE RESERVOIRS TO FLOOD FLOW.

If storage reservoirs were constructed at sites listed in the above summary, the drainage problems of the Lower Sacramento Valley would be greatly simplified. The probable available annual flow from the watersheds tributary to the storage basins is approximately equal to the capacity of the flood basins in the Lower Sacramento Valley. The latter often increase the flood heights on the levees, and are a continued menace to reclamation works, while the storage reservoirs would greatly reduce the flood flow.

The Guenoc reservoir, if constructed, would entirely control the flow from 91 square miles in the watershed of Puta Creek. The rainfall records indicate that the precipitation in this basin is not exceeded by any similar area in California. The maximum discharge at Guenoc dam site in 1904, a year of unusually large rainfall, was 23,325 second-feet.

Monticello reservoir site is located 4 miles above the point where Puta Creek debouches upon the plain. It is believed that if the Guenoc and Monticello reservoirs were built the flood flow of Puta Creek could be so controlled that it would seldom reach dangerous proportions.

The construction of Clear Lake and Little Indian Valley reservoirs would in a measure control the flood flow of Cache Creek if the outlets were regulated with that object in view. Puta and Cache creeks discharge into Yolo basin, and their control would greatly simplify the reclamation of this basin.

The flood wave of Stony Creek could be effectually controlled by the construction of the Mill site reservoir. Ordinary reservoirs are allowed to fill with the first rains. The discharge records on Stony Creek show that the winter flow is many times more than the capacity of this reservoir. The reservoir could have been filled any year since the record began after the 1st of April; by increasing the outlet capacity and keeping the water low this reservoir could be used as a regulator of the flood flow through the rainy season until the 1st of April. The maximum flood flow of this stream exceeds 20,000 second-feet.

If Iron Canyon reservoir should be built with a large outlet capacity, ordinary flood waves could be controlled. If built for irrigation alone, it would still have the effect of retarding the passage of the flood crest on account of the large surface over which the water would be spread and stored before sufficient head was gained on the overflow weir to pass the flood flow.

The Big Valley reservoir on Pit River, if built, could store the entire winter flow from about 4,000 square miles of the watershed tributary to Sacramento River.

The area of the watershed of Feather River, above reservoir sites that have been surveyed in this basin, is 54 per cent of the total drainage area at Oroville, the point where the river leaves the foothills.

The Big Meadows, Butte Valley, Indian Valley, and Grizzly Valley reservoir sites have sufficient capacity to store in years of mean rainfall the entire discharge from 37 per cent of the Feather River watershed. This river is the largest tributary of the Sacramento, and its maximum discharge exceeds 100,000 second-feet. The mean annual rainfall in portions of its watershed exceeds 70 inches.

The area of the watershed tributary to the Iron Canyon, Puta Creek, Cache Creek, Stony Creek, Big Meadows, Indian Valley, Butte, and Grizzly Valley reservoir sites is 48 per cent of the valley of the Sacramento basin. The flood flow from this area would be greatly reduced by the construction of these reservoirs while there would be no interference with the complete utilization of these storage reservoirs for irrigation purposes.

From a study of the available stream-flow data it is believed that Cache Creek, Guenoc, Big Valley, Big Meadows, Butte, Grizzly, and Indian Valley reservoir sites have sufficient capacity to completely hold back the flow from 21 per cent of the watershed of the Sacramento basin during storms.

The statements given above show the intimate relation between reclamation by irrigation and reclamation from overflow. The two problems are in fact one and inseparable. It is believed that it will be difficult to reclaim the Lower Sacramento Valley except by building storage reservoirs, to be operated in connection with levees, and in such way as to offer the greatest protection to the latter. The safety of the reclaimed areas can be further insured by protecting and extending the forested area near the headwaters of the streams.

The investigations previously made on the Lower Sacramento Valley, having for their purpose the reclaiming of the flood basins, have been confined to the problems of channel enlargement and levee protection, the great object being to pass the flood flow to tide water without utilization.

EXPENDITURES.

The expenditures for this work are summarized in the following table:

Expenditures, according to purpose and nature, on proposed Sacramento Valley project to June 30, 1906.

[Total, $36,704.06.]

	Services.	Traveling.	Subsistence.	Equipment.	Supplies.	Rent and storage.	Forage.
Engineering:							
Examination	$11,282.56	$3,796.59	$2,862.75	$976.16	$1,627.88	$300.75	$959.59
Survey	4,549.59	1,334.37	470.93		228.18		327.78
Design	322.70	1.47		.25			
Subdivision		4.00		41.90			
Administration	5,212.52	750.17	288.46		532.47	779.05	53.94

PROPOSED OWENS VALLEY PROJECT.

No further work has been done in Owens Valley, except the continuance of the stream gauging. In the early part of the fiscal year some explorations were made to determine the depth to bed rock at various dam sites, but no detailed surveys or investigations have been made.

A summary of the total expenditures is given in the following table:

Expenditures, according to purpose and nature, on proposed Owens Valley project to June 30, 1906.

[Total, $25,970.38.]

	Services.	Traveling.	Subsistence.	Equipment.	Materials.	Supplies.	Rent and storage.	Forage.
Engineering:								
Examination	$9,457.72	$4,386.86	$925.39	$434.44	$23.38	$814.49	$143.77	$136.46
Survey	2,749.92	581.92	584.75	327.90	6.77	376.84	25.00	232.20
Design	4.44	....	....	....	....	....	....	....
Building:								
Rights and property	217.50	100.60	....	....	....	....	....	....
Administration	2,606.26	1,026.48	20.93	124.55	....	248.62	413.19	....

PROPOSED SAN JOAQUIN PROJECT.

In the early part of the fiscal year the field investigations of the underground water conditions in the San Joaquin Valley were brought to a close. This work included a general examination of the underground water conditions throughout the valley with the object of determining the areas in which underground waters are most accessible for purposes of irrigation or domestic supply.

A summary of the expenditures is given in the following table:

Expenditures, according to purpose and nature, on proposed San Joaquin project to June 30, 1906.

[Total, $3,524.17.]

	Services.	Traveling.	Subsistence.	Equipment.	Supplies.	Rent and storage.
Engineering:						
Examination	$1,624.70	$1,468.03	$93.35	$83.40	$119.95	$15.25
Administration	92.75	15.69	....	3.25	1.95	5.85

CALIFORNIA-ARIZONA.

YUMA PROJECT.

GENERAL STATEMENT.

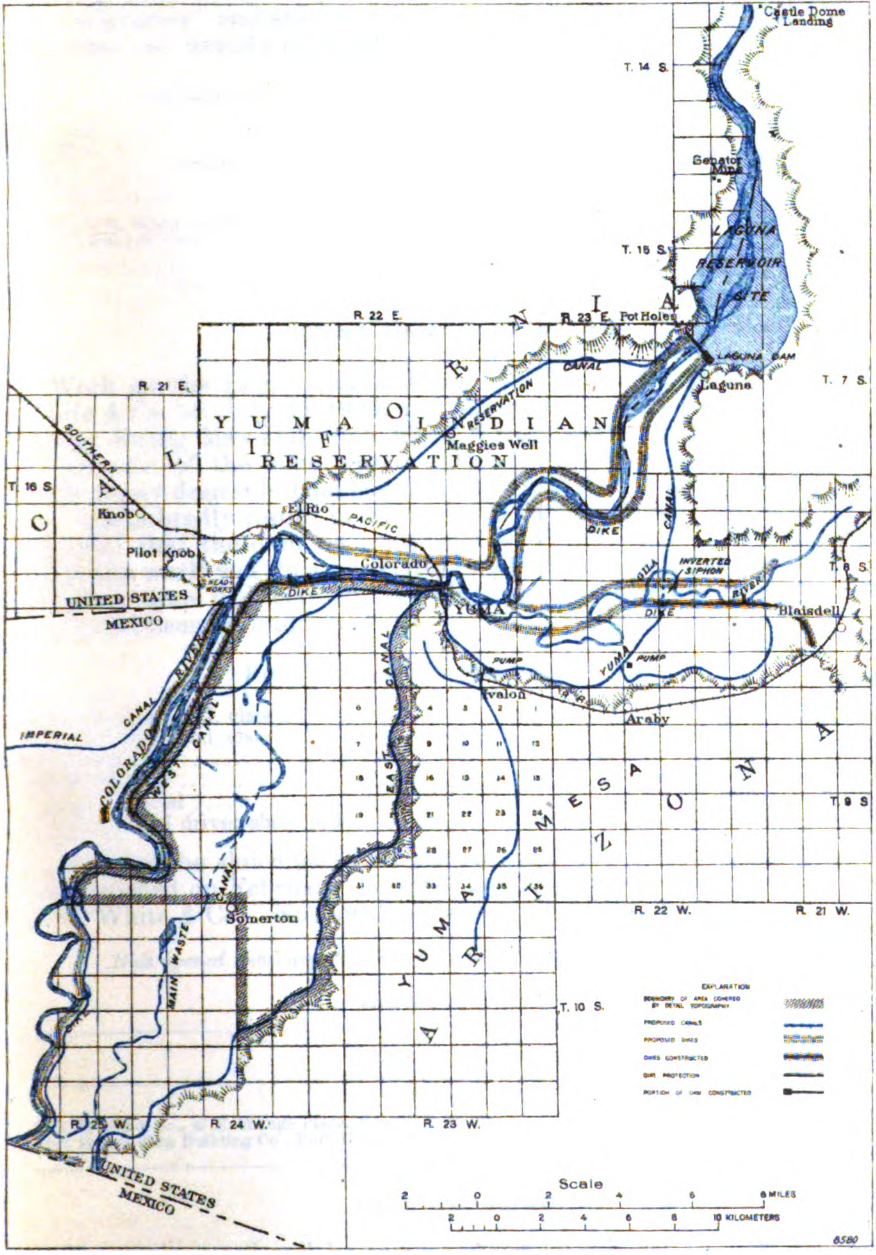
The principal facts relating to the Yuma project are summarized below:

Summary of principal data relating to Yuma project.

Counties: Yuma County, Ariz.; San Diego County, Cal.
Latitude: 32° 30′.
Longitude: 114° 30′.
Townships: 3–13 south, 9–17; ranges 21–23 west, 16–23 east.
Estimated run-off at Yuma: 11,000,000 acre-feet per annum.
Range of temperature: Maximum 118°, minimum 22°, mean 73°.
Average elevation: 100 to 300 feet above sea level.
Principal products: Semitropical fruits; 7 crops alfalfa.
Nearest railroad: Southern Pacific.
Nearest station: Yuma.
Principal markets: Los Angeles and San Francisco.
Irrigable area: 92,150 acres.
Kind of headworks: Diversion dam.
Reservoir area: Settling basin 10 square miles.
Capacity of reservoir: 25,650 acre-feet.
Duty of water: 5.5 feet.
Type of dam: India weir.
Height of dam: 19 feet.
Length of dam: 4,780 feet.
Length of canals: Arizona side, 16 miles, California side, 10 miles.
Length of laterals: 138 miles.
Dikes or levees on Colorado and Gila rivers: 73½ miles.
Per cent public land: 27, including Indian reservation.
Character of soil: Rich alluvium.
Value of irrigated land: $50 to $150 per acre.
Date of completion: 1909, excepting Yuma Indian Reservation, which will probably be the last completed.

At the Yuma project (Pl. XII) the waters of Colorado River will be diverted about 10 miles northeast of Yuma, Ariz., into two canals, one on each side of the river. In Arizona these canals will irrigate all the bottom lands of Colorado and Gila rivers between the Laguna dam and the Mexican boundary, and in California the bottom lands in the Yuma Indian Reservation. The Laguna dam will form a basin in which the velocity of the water will be checked and the greater part of the silt allowed to settle. The water for the canals will be drawn from the surface, where it is comparatively free from silt. The dam will have a total length of 4,780 feet, a maximum width of 257 feet, and a maximum height of 19 feet.

Suitable quarters and offices for the employees of the Service and warehouses and corrals have been erected at Yuma (Pl. XIII). Preparations for the installation of an electric lighting plant have been



GENERAL PROGRESS MAP YUMA PROJECT ARIZ.-CALIF.

made and facilities increased for handling additional stock and material.

In the following table are listed the contracts entered into for building work on the Yuma project. This list includes all contracts for excavation, embankment, masonry, and erection of structures, but does not include materials such as cement, steel, timber, etc.

Contracts for building works on Yuma project to June 30, 1906.

No. of contract.	Contractor.	Feature.	Estimated total value.[a]	Payments to June 30, 1906.	Per cent paid.
51	J. G. White & Co.	Laguna dam	$797,650	$162,330.57	20
64	Miller & Peasley	Yuma dike	66,325	72,763.20	100

[a] For a discussion of advance estimates and final costs, see page 51.

LAGUNA DAM[a] AND GATES.

Work on the Laguna dam (Pls. XIV-XXI) was begun by J. G. White & Co. on July 20, 1905, and has been carried on continuously except during May and June, when it was practically at a standstill on account of the high water. During this time the contractors made many desirable changes in their plant and track system that will undoubtedly result in more rapid construction. The contract required that the dam be completed by July 6, 1907. On June 30, 1906, the work was 26.4 per cent completed and 47.4 per cent of the contract time had elapsed. On June 30 the following amount of work had been accomplished.

Work done on Laguna dam, June 30, 1906.

Material excavated, class 1	cubic yards	70,900
Material excavated, class 2	do	197,487
Rock placed	do	53,418
Pavement laid	square yards	5,554
Concrete placed	cubic yards	4,464
Furnished and driven sheet piling	linear feet	35,799

Bids for the sluice gates for the Arizona side of the Laguna dam were opened on February 28, 1906, and the contract was awarded to J. G. White & Co. No work has been done on this contract.

Bids opened February 28, 1906, for gates at Laguna dam, Yuma project.

[Specifications No. 72.]

Bidder.	Price.	Time.
		Days.
J. G. White & Co., 43 Exchange Place, New York, N. Y.	$65,900	200
Port Huron Ship Building Co., Port Huron, Mich.	72,500	320

GILA CROSSING.

The main canal will be carried under Gila River by means of an inverted siphon 2,700 feet long. The original plans for the Gila Crossing contemplated a pipe line 3,200 feet long, but the relocation of the Gila Valley dikes has resulted in shortening the length of this siphon 500 feet. This siphon will consist of three reenforced concrete pipes, 10 feet 6 inches in diameter, and will have the same capacity as the main canal, 1,300 second-feet. The pipes will be sunk to a sufficient depth below the bed of the river to be safe from scour during floods. Plans for this crossing have been prepared, but the work has not been started.

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[a] See Third Ann. Rept. Reclamation Service, Pl. XV.

DIKES.

In order to protect the lands from overflow it has been necessary to construct dikes along both Gila and Yuma rivers. The final location of the Yuma Valley dike was completed in the spring of 1905, and work was begun on the first 12 miles in October, 1905, by Miller & Peasley, the lowest bidders. This work was completed and accepted in March, 1906. This dike was afterwards extended for 1½ miles, the work being done under small contracts awarded to local bidders. Clearing and grubbing of the right of way of this extension, as well as necessary protection work, was done by force account.

A topographic map of the Gila Valley, showing changes in river location and topography due to extreme high flood, was completed in September, 1905. Immediately thereafter the line of the Gila Valley dike was located and preparations were made to begin the work. On account of the great risk to be assumed by any contractor, equipment was purchased and the work was carried on by force account. The progress made and cost reports show this to be a satisfactory method. Approximately 6 miles of levee, or 40 per cent of the entire work planned, was completed by June 30, at a cost to the United States of .129 cent per cubic yard.

YUMA CONDUIT.

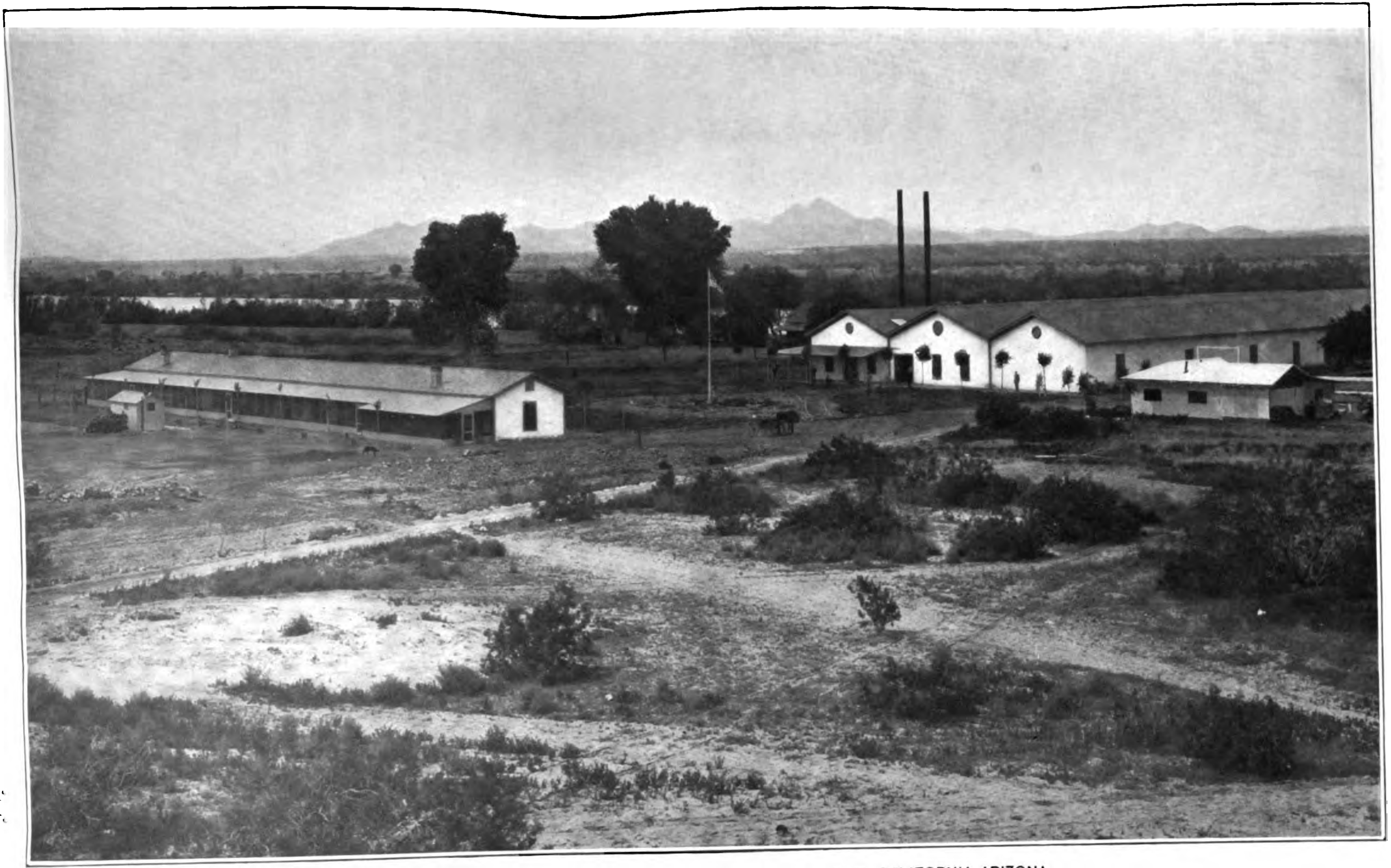
Plans have been prepared for a conduit to carry the water of the main canal through the town of Yuma. This conduit will be built of reenforced concrete, and will have a capacity of 900 second-feet, the same as the main canal at this point. It will be horseshoe shaped, the width and height both being 10 feet 6 inches, and will be an inverted siphon in part with a tunnel section at each end with paved approaches. The total length will be about 2,500 feet. This work will be carried on by force account. Rights of way for this conduit through Yuma have been obtained.

DISTRIBUTION SYSTEM.

A detailed topographic survey of the valley has been made, and all the existing canals and improvements have been located on the maps. Estimates of the values of present canals and their headworks have been completed, and all other data collected to make a comprehensive study for a complete system, using the existing canals as far as possible. The section lines have been relocated over the greater portion of the valley.

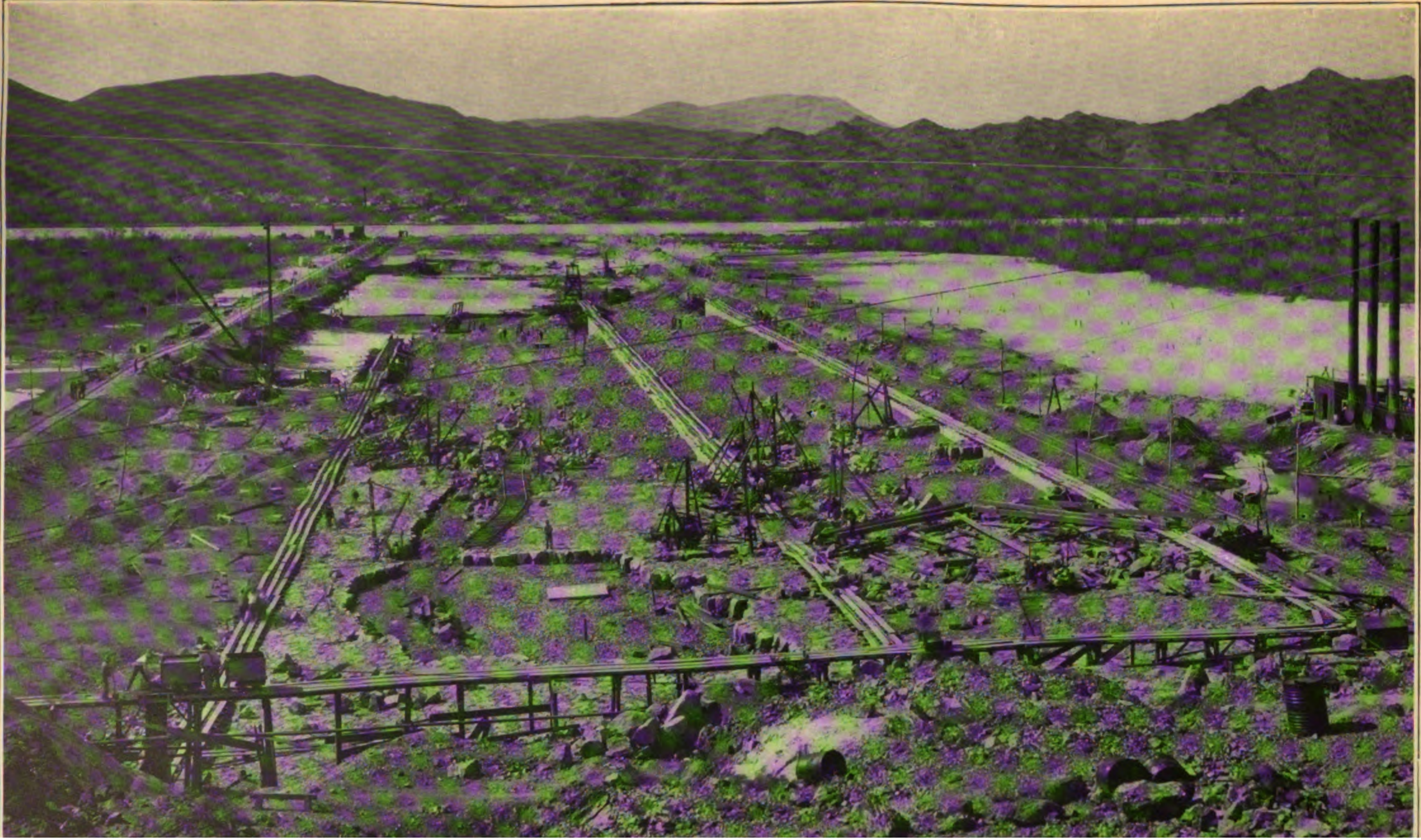
IRRIGABLE LANDS.

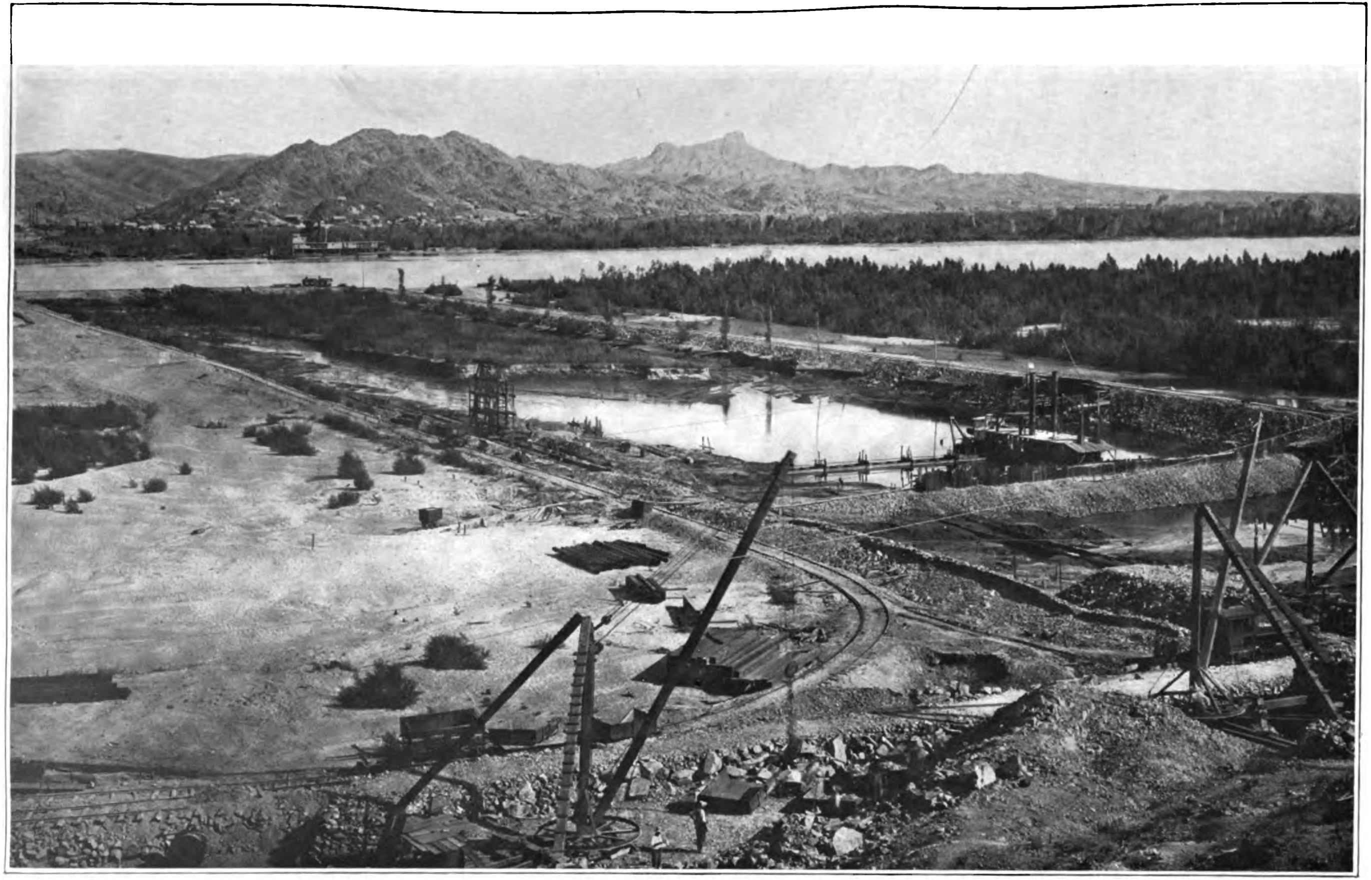
The area comprised in the Yuma project consists mainly of rich alluvial bottom land that is exceedingly fertile. It is believed that the plant food carried by the silt and in solution in the river water will perpetually fertilize the land. This region is well adapted to



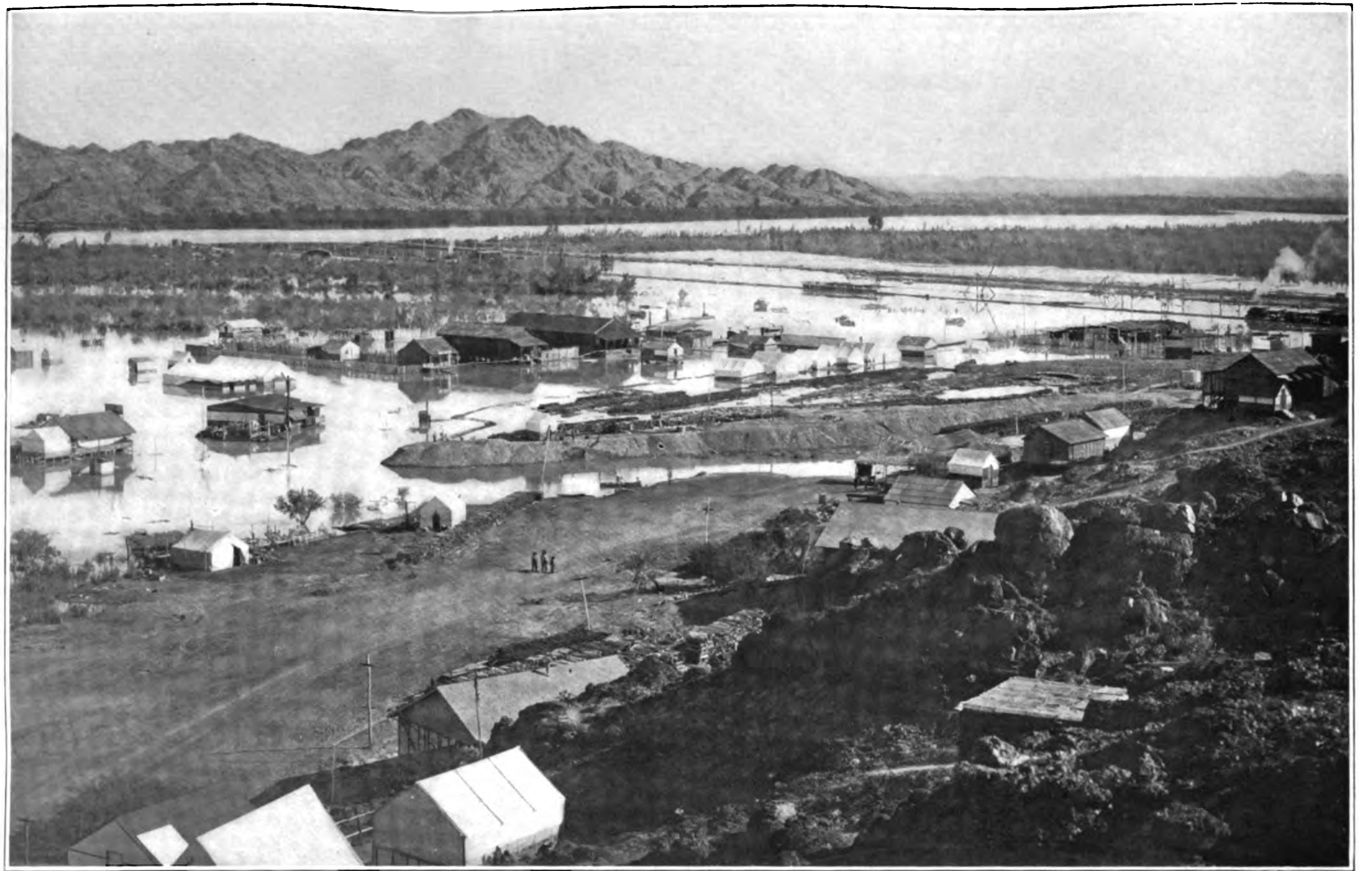
U. S. RECLAMATION SERVICE HEADQUARTERS, YUMA PROJECT, CALIFORNIA-ARIZONA.

The old U. S. Quartermaster's depot, on south side of the Colorado River, just above Yuma, Ariz., May 26, 1906.





LAGUNA DAM, YUMA PROJECT, CALIFORNIA-ARIZONA, FROM THE CALIFORNIA SIDE, JULY 26, 1906.



LAGUNA DAM, YUMA PROJECT, CALIFORNIA-ARIZONA, FROM THE ARIZONA SIDE DURING THE TIME OF HIGH WATER, MAY 29, 1906.

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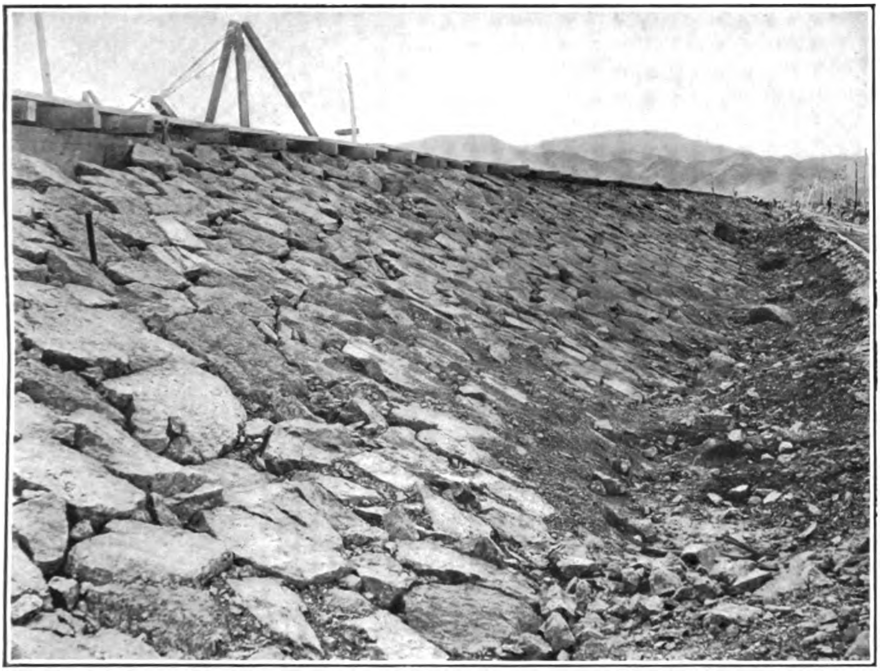
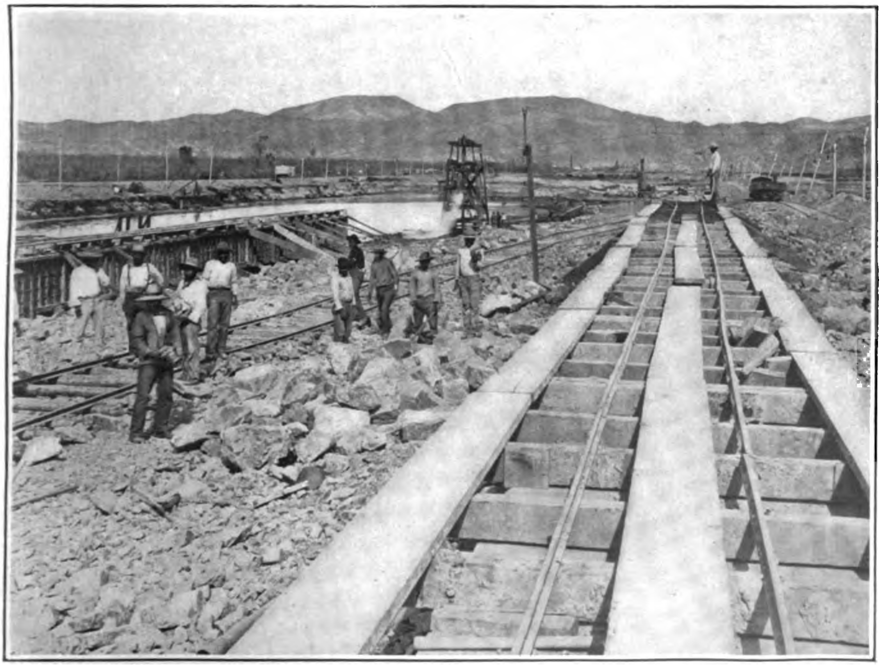
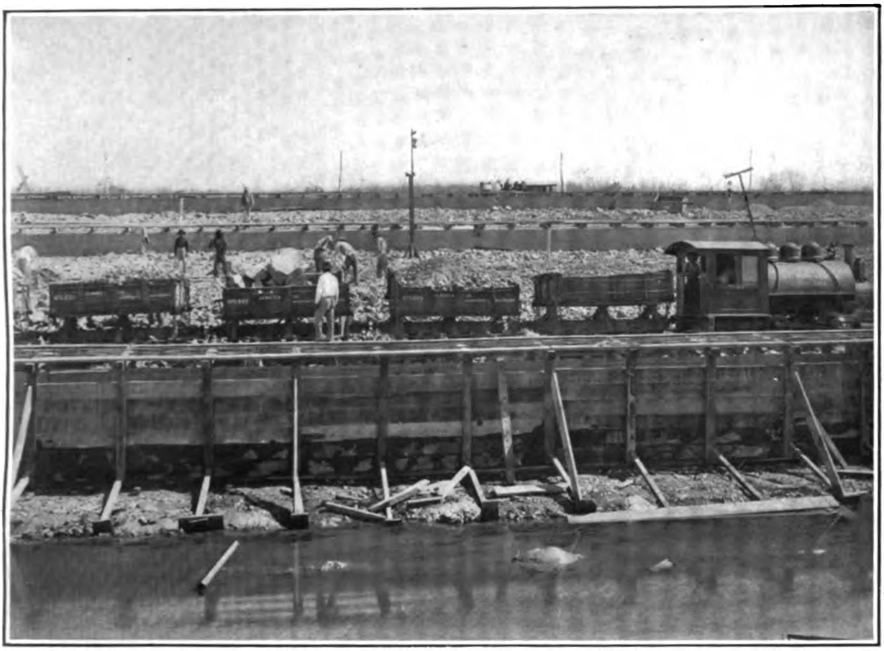


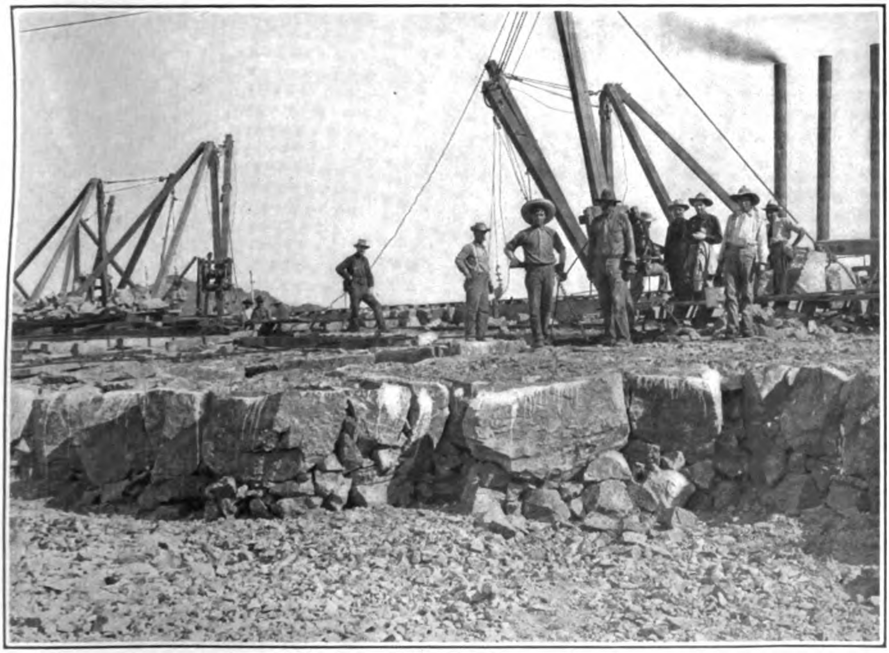
A. COMPLETED SECTION OF UPSTREAM FACE OF THE LAGUNA DAM, YUMA PROJECT, CALIFORNIA-ARIZONA, MARCH 26, 1906.



B. ROCK FILL, CREST, AND MIDDLE CORE WALLS OF THE LAGUNA DAM, YUMA PROJECT, CALIFORNIA-ARIZONA, MARCH 28, 1906



A. CORE WALLS AND ROCK FILL, LAGUNA DAM, YUMA PROJECT, CALIFORNIA-ARIZONA, LOOKING ACROSS THE DAM FROM BELOW THE LOWER CORE WALL, MARCH 28, 1906.



B. SECTION OF ROCK PAVING BETWEEN CORE WALLS OF LAGUNA DAM, YUMA PROJECT, CALIFORNIA-ARIZONA, MARCH 28, 1906.

semitropical fruits, and forage products, seven crops of alfalfa being raised in many places. The distribution of the lands under the project is shown by the following table:

Lands included in Yuma project.

	Acres.	Percentages.
GENERAL SUMMARY.		
Total	97,000	....
Private	72,400	75−
Public	24,600	25+
Irrigable	92,150	95
Nonirrigable	4,850	5
PRIVATE.		
Total	72,400	....
Irrigable	68,780	95
Nonirrigable	3,620	5
PUBLIC.		
Total	24,600	....
Irrigable	23,370	95
Nonirrigable	1,230	5
IRRIGABLE.		
Total	92,150	....
In Yuma County, Ariz	76,000	81
In San Diego County, Cal	16,150	19+
Gila River Valley	20,758	20+
Yuma Valley	55,242	60
Yuma Indian Reservation, Cal.	16,150	20+
Under existing canals	56,000	60+
Not under existing canals	36,150	40−
Public	68,780	75−
IRRIGABLE—continued.		
Private	23,370	25+
Subscribed (private)	62,415	91−
Unsubscribed (private)	6,365	9+
NONIRRIGABLE.		
Total	4,850	....
Public	1,230	25+
Private	3,620	75−
IN YUMA COUNTY, ARIZ.		
Total	80,000	....
Private	72,400	90+
Public	7,600	10−
Irrigable	76,000	95
Nonirrigable	4,000	5
IN SAN DIEGO COUNTY, CAL.		
Total	17,000	....
Private	160	....
United States Indian reservation land	16,840	....
Irrigable	16,150	95
Nonirrigable	850	5

CONDITIONS IN IMPERIAL VALLEY.

Since the California Development Company, operating under a different name as a Mexican organization, made the dredger cut at what is known as the Mexican heading into the Imperial canal, many attempts have been made to turn the Colorado back into its old channel. At first, the magnitude of the undertaking was not at all appreciated and the early attempts at closure were futile, owing both to poor judgment in the method of closure and to lack of available funds.

About a year ago a more determined attempt was made and a brush-and-mat dam, supplemented by piles, was driven across the line of the intake. This attempt had raised the water between 2 and 3 feet, when the great flood in the Gila of November, 1905, overtopped it and destroyed the entire work. From that time on the new channel of Colorado River, which followed the old Imperial canal, became wider and deeper until the entire flow of Colorado River, even during the great flood season, was passing down into the Imperial Valley, overflowing the country, destroying ranches, and filling up the Salton Sea.

The rising of the water in the Salton Sea compelled continual changes in the location of the Southern Pacific Railroad tracks and forced upon the management an appreciation of the enormous damage that would result unless the river were permanently restored to its old channel.

At Pilot Knob, 4 miles above the break, permanent concrete headworks were constructed, and to the south of the new channel of

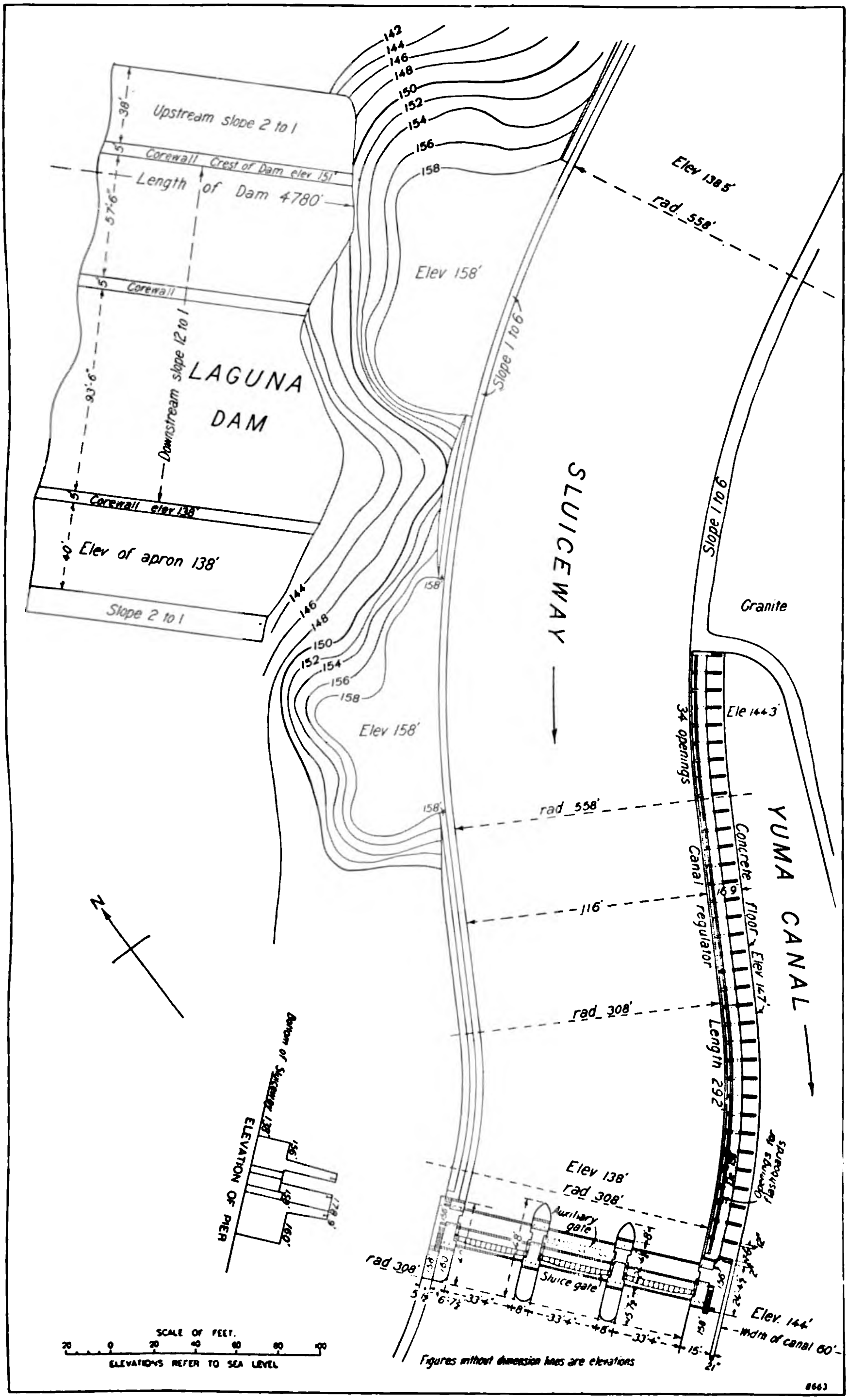
Colorado River at the Mexican intake and along the line of the proposed dam there were erected some large wooden gates through which it was intended to divert the entire flow of the Colorado during low water. A line of railroad was built from a point near El Rio past Pilot Knob to the Mexican intake, and a line of piling driven across the new channel about a thousand feet below where it left the old channel. Levees were built from either side of the river as the water fell lower and lower. At points about 500 feet apart in the river and along the located line of the trestle two bulkheads were built, one composed mostly of rock and brush, on the south side, and the other almost entirely of fascines, on the north side. A mat 100 feet long, up and down stream, was placed on the bottom between these abutments, the piles of the trestle pinning the mat to the bottom. Over part of this mat a second mat was placed.

Immediately after the construction of the railway across the river the operation of building the remaining 500 feet of dam between the two abutments was begun. Steam shovels loaded 40-yard automatic dump cars at quarries 4 miles away, and train loads of these cars were run out on the trestle and the material dumped into the river upon the mat. Gradually the river rose until, on October 10, the difference in elevation of the water above and below the dam was 6 feet and practically the whole river was flowing through the gates.

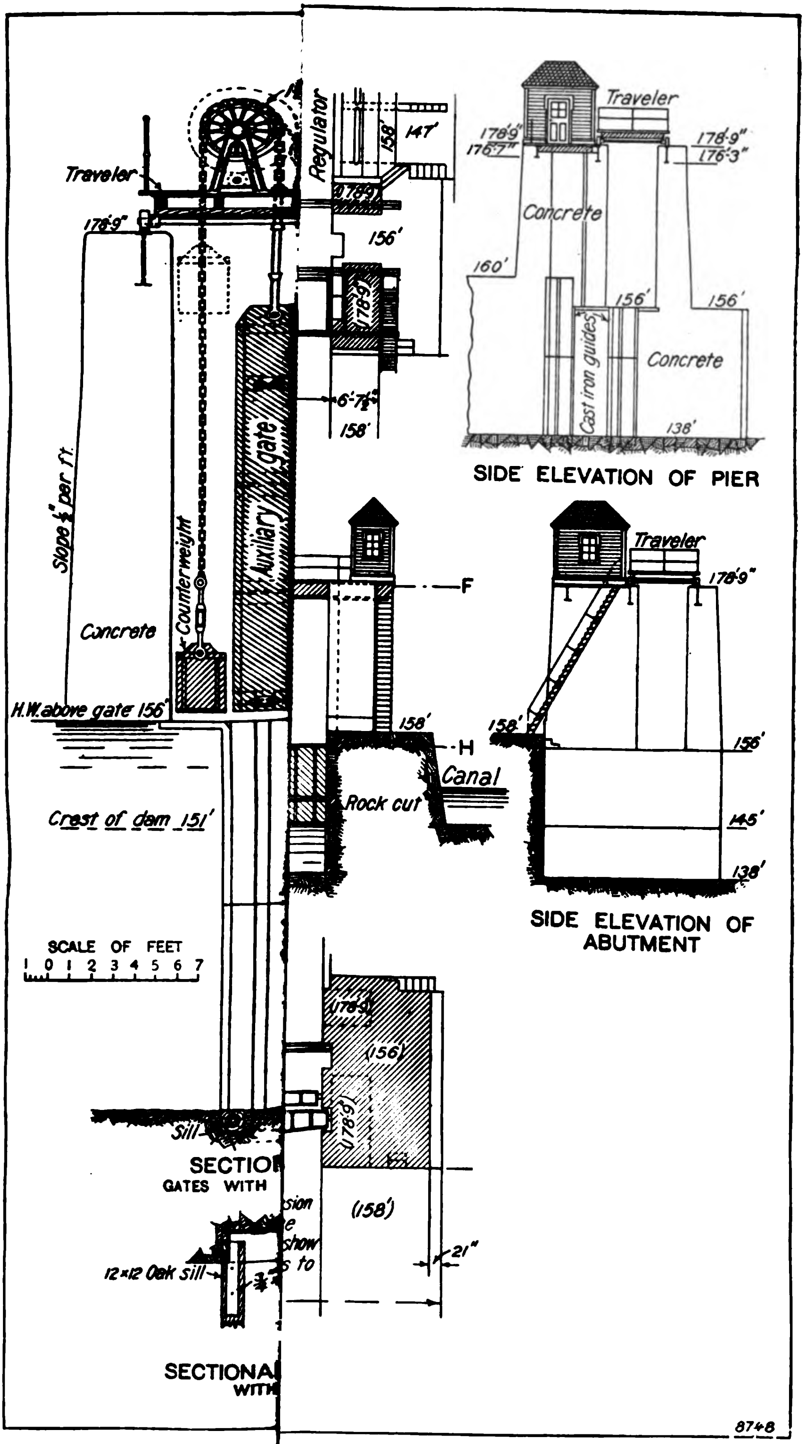
The engineers in charge had detected cutting in front of and below the gates and in anticipation of their failure had built a trestle across the river above the gates, with the intention of dumping in enough rock to partially close the gates and relieve the situation there. At 3.15 on Thursday, October 11, a large part of this gate, known as the Rockwood gate, went out. The river rapidly scoured a deep channel, lowering the surface of the water above the dam until there was only a difference in elevation of about 3 feet. Work was immediately begun on repairing the trestle below the gates, which had been injured both by the increased flow and by the timber carried away from the gate. From all the available quarries within a radius of from 300 to 400 miles rock was hurried to this point and dumped rapidly from the lower trestle. At the same time the trestle which had been started above the gates was strengthened, and as soon as it was in shape cars were run out on that and rock dumped in. In the meantime part of the material which had been dumped between the two abutments in the river, and over which the overflow had taken place, was removed and gradually the channel through the Rockwood gates was filled up.

When this was entirely filled so as to throw the entire flow of the river over the central portion of the dam, the filling of this portion was again resumed. Large blocks of granite weighing several tons, as well as smaller material, was hauled out as rapidly as trains could bring it, and gradually the gap was closed. The river during all this time did not go below about 9,000 second-feet, adding materially to the difficulties expected.

On November 1 there was a difference of 11 feet in the elevation of the water below and above the dam, and about one-half the water in the Colorado was going down its old channel. By noon of November 4 the dam was high enough to turn practically the entire flow of Colorado River to its old channel. On December 7 the river again broke through and the greater part of the flow of Colorado River has since made its way into the Salton Sink.



PLAN OF SLUICE GATES, CANAL REGULATOR, ETC., ON ARIZONA SIDE OF LAGUNA DAM, YUMA PROJECT, CALIFORNIA-ARIZONA.



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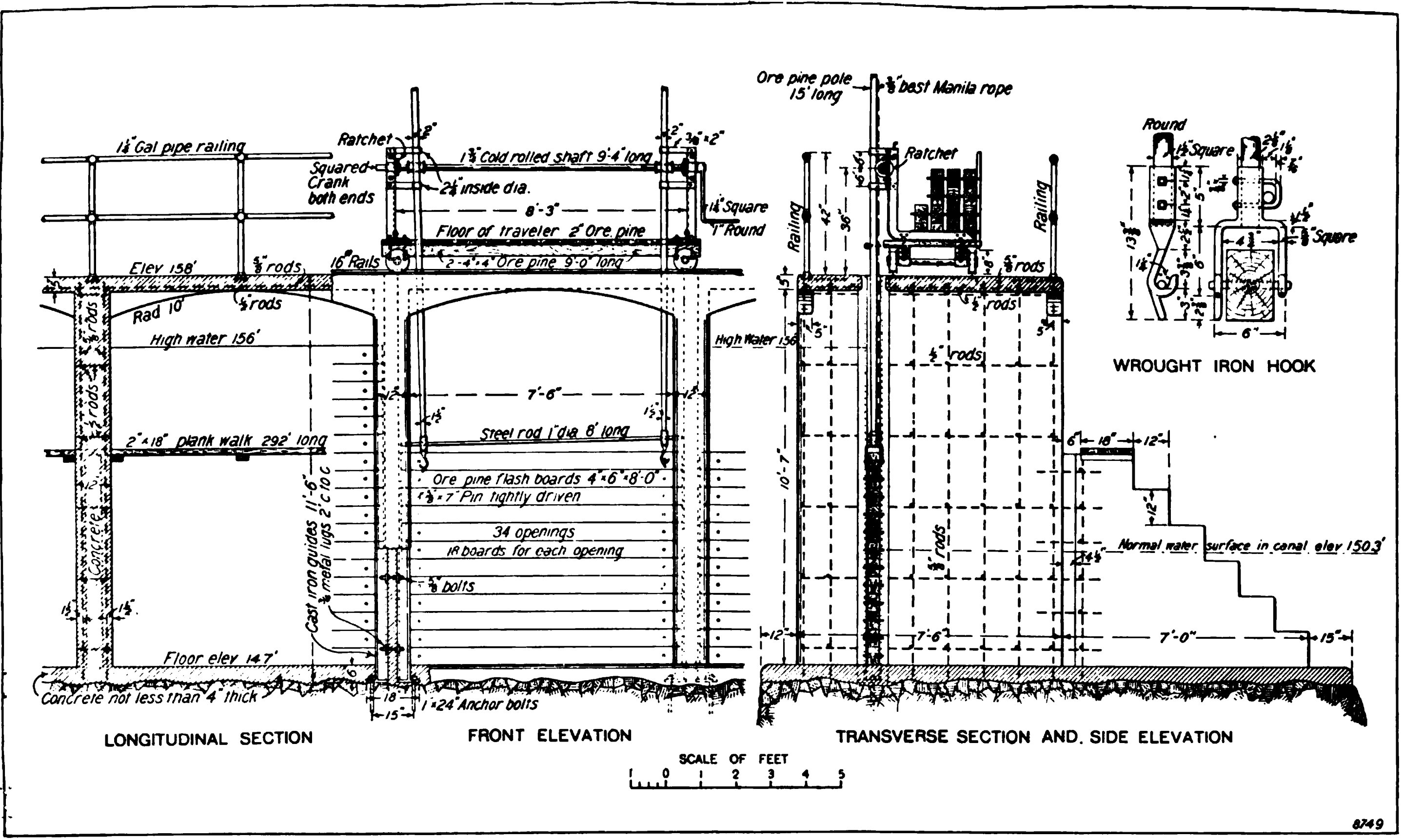


DETAILS OF CANAL REGULATOR, LAGUNA DAM, YUMA PROJECT, CALIFORNIA-ARIZONA.

EXPENDITURES.

The expenditures on the Yuma project are summarized in the following tables:

Expenditures, according to physical features, on Yuma project to June 30, 1906.

Features.	Engineering and administration.	Building.
Incidental structures:		
Headquarters, office, and warehouse	$374.96	$7,124.23
Barracks	192.61	3,659.67
Corral	42.42	805.99
Improvement—grounds	74.48	1,415.04
Irrigation structures:		
Laguna dam	17,329.16	213,575.81
Laguna dam sluice gates and regulator gates	2,720.16	....
Gila dikes	4,699.43	56,715.68
Yuma dikes	7,342.87	90,524.28
Gila crossing	292.36	....
Yuma conduit	1,201.99	....
East-side canal	1,874.39	....
West-side canal	2,209.65	....
Main canal	3,675.95	....
Distribution system	10,558.91	....
Irrigable lands:		
Farm unit subdivision	184.13	....
Examination of Yuma project and other prospective projects on Colorado River	158,769.59	....
Administration of project as a whole	68,028.13	....
Total	263,204.66	390,617.23
Grand total	....	653,821.89

Expenditures, according to purpose and nature, on Yuma project to June 30, 1906.

[Total, $653,821.89.]

	Services.	Traveling.	Subsistence.	Equipment.	Materials.	Supplies.	Rent and storage.	Forage.	Job work.
Engineering:									
Examination	$81,760.19	$14,189.27	$27,377.14	$15,149.77	$35.76	$14,724.85	$25.84	$5,506.77	....
Survey and inspection	31,858.07	5,870.66	1,746.43	5,685.42	2.10	960.86	7.18	232.09	....
Design	5,400.57	335.31	105.05	259.62	3.50	91.04	31.44	....	....
Subdivision	131.80	34.93	....	7.18	....	8.78	1.44	....	....
Building:									
Rights and property	2,266.68	90.55	75.41	.50	150.00	16,200.05	....	....	....
Building	48,690.12	1.592.82	7,958.70	27,091.07	13,774.26	11,238.64	....	5,876.74	$239,245.16
Administration	43,003.72	4,966.84	5,074.19	5,183.47	114.95	6,593.00	1,923.12	1,168.84	....

COLORADO.

UNCOMPAHGRE VALLEY PROJECT.

GENERAL STATEMENT.

The principal facts relating to the Uncompahgre Valley project are summarized below:

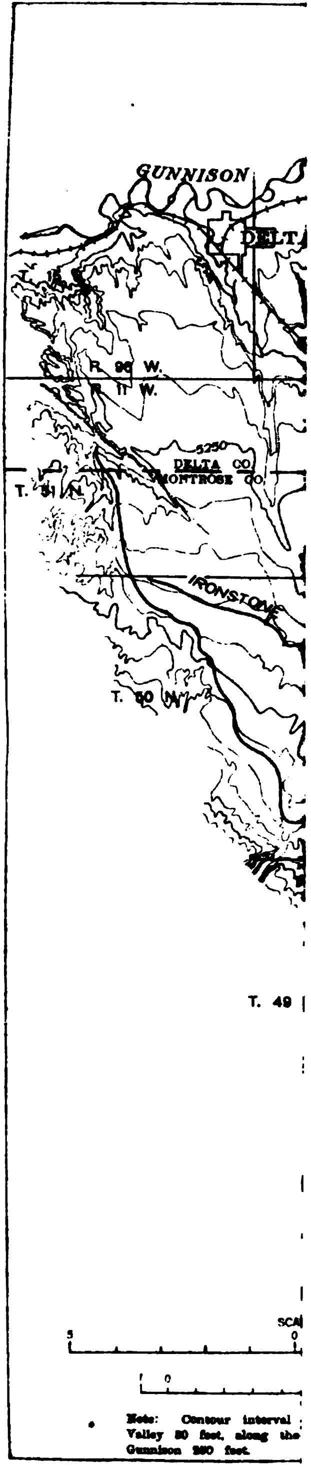
Summary of principal data relating to the Uncompahgre Valley project.

Counties: Montrose and Delta.
Latitude: 38°.
Longitude: 108°.
Townships: 15 south, range 94–96 west; 48–51 north, range 7–12 west.
Rainfall: Montrose, 6 to 11 inches; Gunnison, 7 to 13 inches; Whitepine, 8 to 20 inches.
Range of temperature: Maximum, 98°; minimum, 20°; average, 48°.
Average elevation: 5,000 to 6,400 feet.
Principal products: Alfalfa (three crops), hay, cereals, sugar beets, fruits, vegetables.
Nearest railroad: Denver and Rio Grande.
Nearest station: Montrose (8 miles from Gunnison tunnel); Olathe and Delta on project.
Principal market: Denver; local mining camps.
Irrigable area: 146,886 square miles.
Watershed area: 3,850 square miles.
Kind of head works: Diversion dam.
Duty of water: 1 cubic foot per second at the head gates for every 80 acres.
Length of canals: South canal, 12 miles; east canal, 35 miles; west canal, 30 miles.
Power development: Drops along south canal 15,000 to 20,000 horsepower.
Tunnel: Gunnison, 30,583 feet.
Tunnels on south canal: 2,000 feet.
Capacity: 1,300 second-feet.
Per cent public land: 20.
Character of soil: Red disintegrated sandstone, gravel, adobe, and clay loam.
Value of irrigated land: From $50 to $500 per acre.

The Uncompahgre Valley project (Pl. XXII) includes mesa and valley land on the western slope of the Rocky Mountains at an elevation of 5,000 to 6,000 feet above sea level. About 60,000 acres are fruit lands and 80,000 acres general farming lands. The fruit lands when properly irrigated and cultivated are very valuable, and when planted with apples and peaches some of them net as much as $500 per acre per annum. The valley lands, when properly handled and with an adequate supply of water, are also valuable for raising sugar beets and other root crops, as well as many kinds of grasses and cereals. About 20,000 acres have been very inadequately irrigated with the waters of Uncompahgre River. Six miles away, and about parallel with the Uncompahgre Valley, is Gunnison River, which drains a large area reaching to the summit of the Rocky Mountains.

As Uncompahgre River does not carry sufficient water to irrigate the crops in the valley, the water of Gunnison River will be brought to the Uncompahgre Valley, through the intervening mountain range,

U. S. RECLAMATION SERVICE,



by means of a tunnel 30,580 feet in length. The inlet of this tunnel is about 12 miles distant from and 250 feet higher than the point on Uncompahgre River where the water is to be carried to command all of the irrigable lands in the valley. This necessitates the excavation of a canal of the full capacity of the tunnel (1,300 second-feet) through an extremely hilly and broken country.

One of the first steps in the development of this project was the building of a road into the canyon of Gunnison River, as there was no way by which materials and supplies could be carried to that place. This road was completed late in 1904, and has given satisfactory service. In order to facilitate the building of the irrigation system, a telephone line was built from Montrose to the two ends of the tunnel. Both the telephone system and the roads will be of permanent value in the maintenance and operation of the project when it is completed. In the section of this report devoted to a description of the Gunnison tunnel, reference is made to the necessity of providing additional facilities for carrying on the work after it had been taken over by the Government. Steam and electric power plants and machine shops were established, and provision has been made for housing the men and animals and for storing the supplies that must be kept on hand. A general office and headquarters building has been erected at Montrose, where the main office for the project is located.

In the following table are listed the contracts entered into for building work on the Uncompahgre Valley project. This list includes all contracts for excavation, embankment, masonry, and erection of structures, but does not include materials, such as cement, steel, timber, etc.

Contracts for building work on Uncompahgre Valley project to June 30, 1906.

No. of contract.	Contractor.	Feature.	Estimated total value.[a]	Payments to June 30, 1906.	Per cent paid.
20	E. A. Hess	Telephone	$6,384.00	$5,641.60	100
21	Knowlton & Bollen	South canal, divisions, 1, 2, 7 to 9.	39,668.00	41,010.38	100
22	Orman & Crook	South canal, divisions 3 to 5	28,785.00	33,509.85	100
23	Kellogg & Worley	South canal, divisions 6	7,060.00	9,973.27	100
25	Taylor-Moore Construction Co.[b]	Gunnison tunnel	1,008,500.00	18,890.05	2
44	J. J. Kewin	Office building	4,166.00	4,166.00	100
66	Orman & Crook	South canal, divisions 10 to 21.	513,365.00	139,132.92	27

[a] For a discussion of advance estimates and final costs see page 51.
[b] Contractor in default. Work carried on by force account.

GUNNISON TUNNEL.

Bids for building the Gunnison tunnel were opened October 5, 1904, and the contract was awarded to the Taylor-Moore Construction Company, of Hillsboro, Tex. The contractors had great difficulty in securing proper bonds, and did not commence work until February, 1905. They carried on the work until the end of May of the same year, when they gave up their contract.

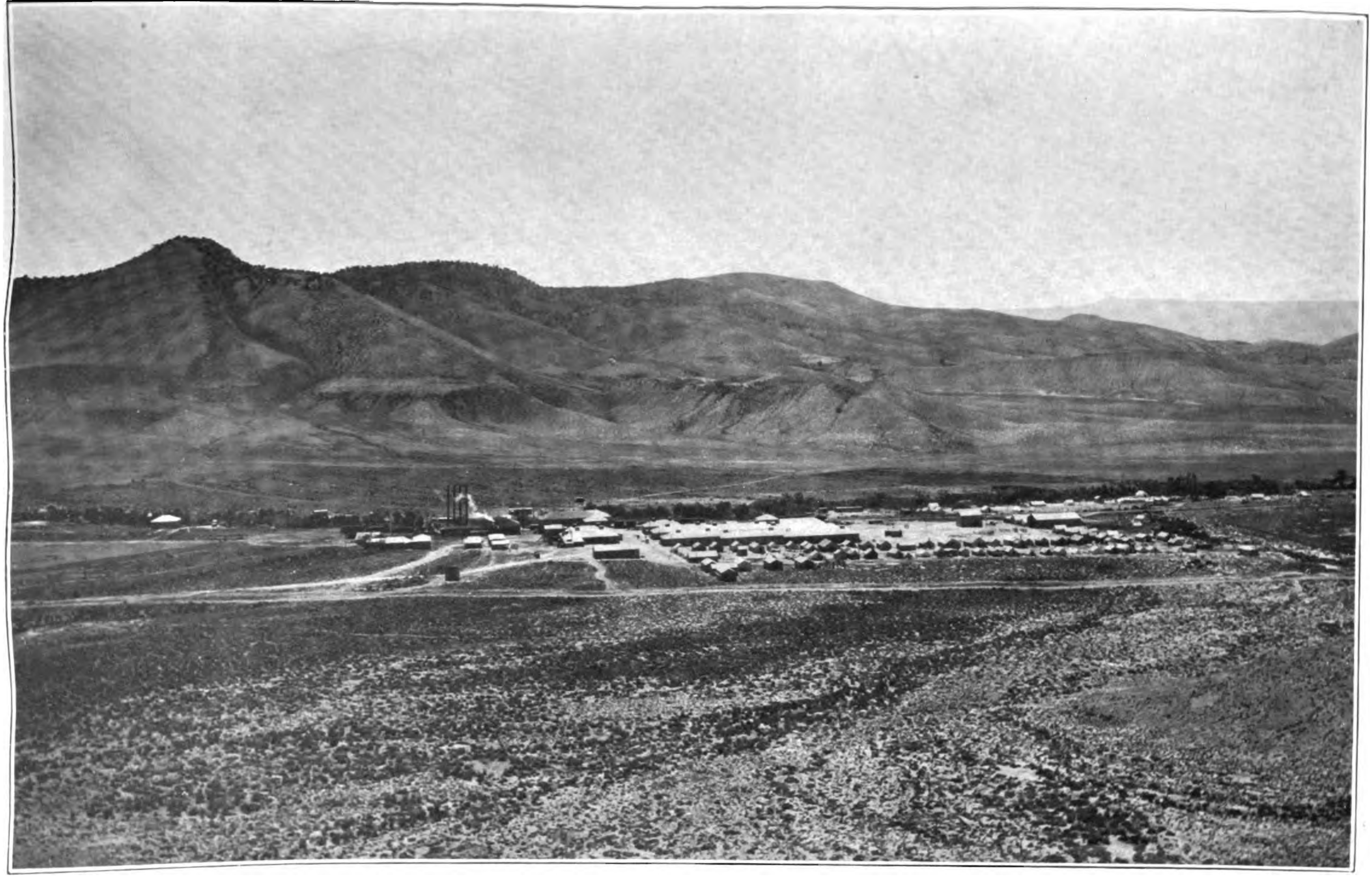
As soon as possible after the surrender of the contract by the contractor new specifications were prepared and proposals for completing the work were opened on September 26, 1905. All the bids received were rejected, and it was decided to complete the work by force account. In the interval the organization left by the contractor was gone over and strengthened. Incompetent foremen were replaced by able men, accounts were systematized, methods of work improved, and the power plants and camps were enlarged to capacities somewhat adequate to the immediate demands. When the completion of the work by force account was authorized the conditions were about as follows:

At the west or Cedar Creek portal work was being carried on in two headings—one running eastward from the west portal, one running eastward from a shaft which was sunk to grade at a point 4,950 feet from the west portal. The portal cut, 1,800 feet long and containing approximately 120,000 cubic yards of material, was about one-fourth excavated in the portion in which the work was easiest. The power plant consisted of one air compressor and two boilers and was entirely inadequate. The badly located camp was a collection of tents, provided with a dangerous and inadequate water supply and without sanitary or other conveniences. At the east or Gunnison River portal work was being carried on in a single heading. Conditions were much the same as at the west portal, except that an abundant supply of pure water was available.

As winter was approaching it was essential to improve the living quarters without delay. At the west portal the entire camp was shifted nearly a mile to a more convenient locality. As rapidly as lumber and labor could be procured dining halls, bunk houses, storerooms, offices, power house, stables, and cottages were erected. Good water and sewer systems were established; policemen and sanitary inspectors were appointed, and good stores, boarding houses, and hospitals were started. The power house was equipped with air compressors, pumps, boilers, electric generators, and all necessary accessories. The tunnel was provided with cars and electric locomotives. Circuits were established whereby all headings and buildings could be provided with electric light. The forces were increased to the fullest extent to which they could be worked economically, and during the greater part of the time after August 1, 1905, 350 men were employed at this portal alone. A town of some 800 inhabitants has grown up, with a United States post-office named Lujane, Colo. (Pl. XXIII.)

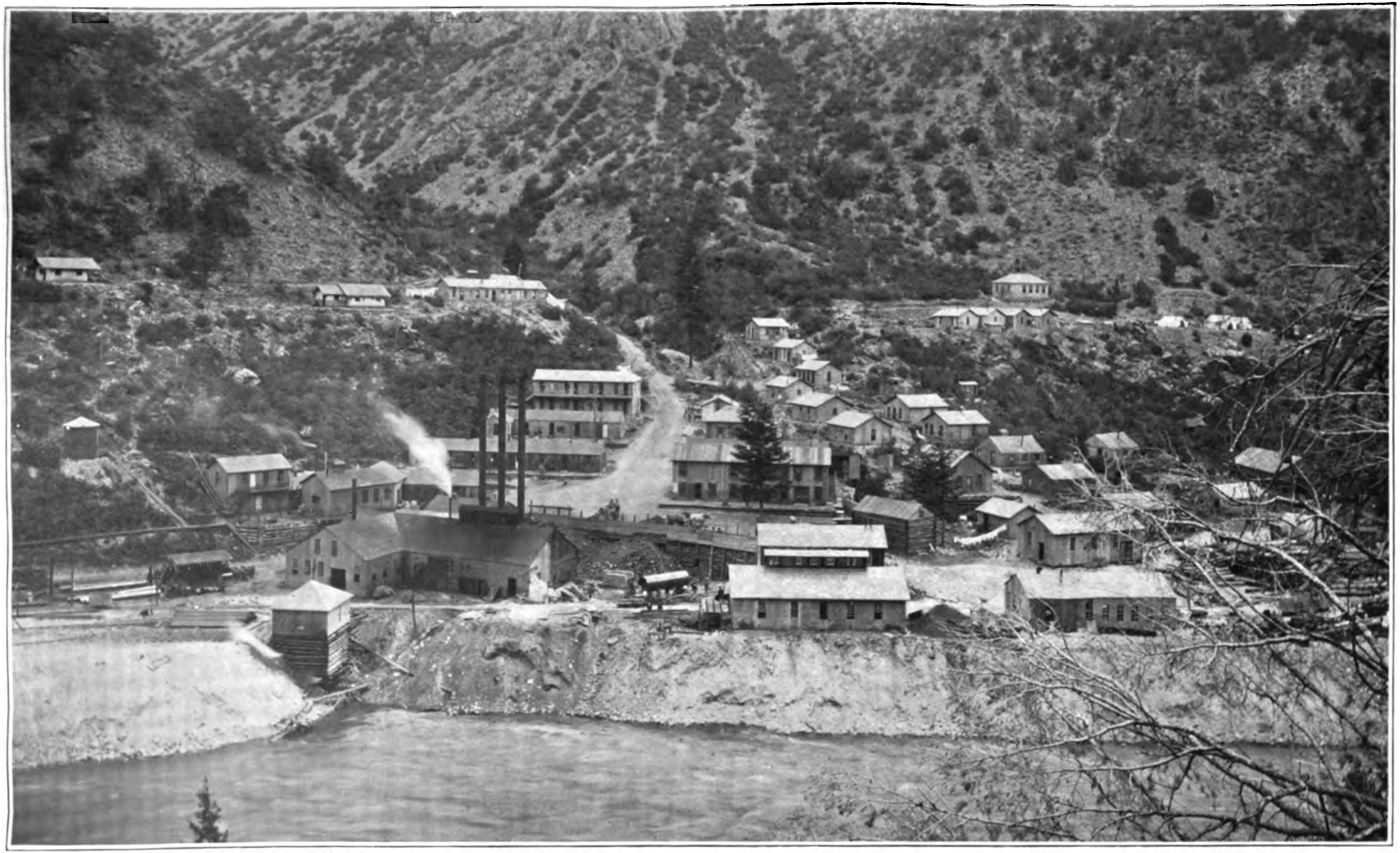
At the east portal similar changes have been made. As this camp is in a deep and almost inaccessible canyon, 12 miles from railroad facilities, it was necessary to provide very fully against emergencies. The tent houses have been replaced by frame structures covered with building paper. A large stock of repair parts for machinery, groceries, explosives, coal, and other commodities must be accumulated during the summer months in order to continue the work during the winter and spring, when the wagon road is apt to be rendered impassable by rain or snow storms. One hundred and forty men are employed at this camp, which is also a United States post-office, bearing the name of River Portal, Colo. (Pl. XXIV.)

Before a proper appreciation of the difficulty of this work can be realized it must be recognized that in many respects it is an unprecedented undertaking. At the present time an expenditure of nearly 100 horsepower is required for tunnel ventilation alone. Every car of material taken from the tunnel must be hauled an average distance of 2 miles before it reaches the dump. Water flowing into the tunnel must be pumped long distances before it is finally discharged. The



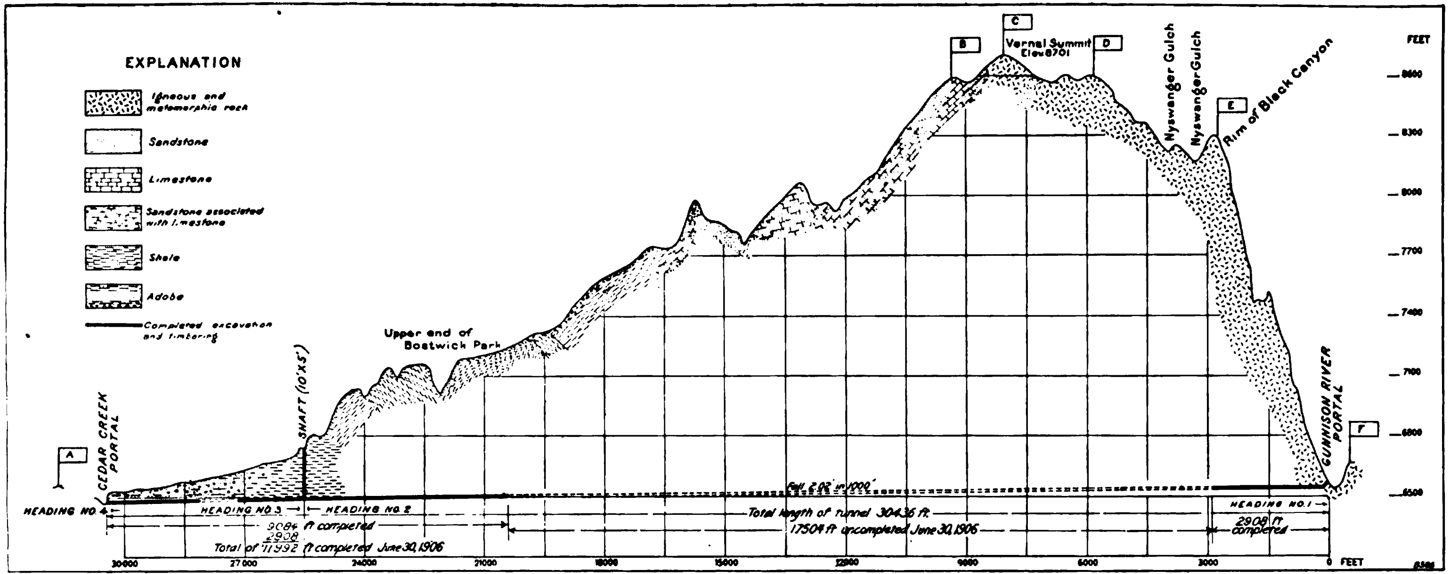
LUJANE, COL., AT THE WESTERN END OF THE GUNNISON TUNNEL, UNCOMPAHGRE VALLEY PROJECT, COLORADO.

All the inhabitants are employees of the U. S. Reclamation Service.



RIVER PORTAL, COLORADO, IN THE GUNNISON CANYON, AT THE EASTERN END OF GUNNISON TUNNEL, UNCOMPAHGRE VALLEY PROJECT, COLORADO.

All the inhabitants are employees of the U. S. Reclamation Service.



PROFILE OF GUNNISON TUNNEL, UNCOMPAHGRE VALLEY PROJECT, COLORADO, SHOWING PROGRESS OF WORK, JUNE 30, 1906.

material through which the tunnel has been excavated has been extremely difficult to handle in many places. The country in which the work is located is not self-supporting. This has required the shipment from outside points of practically every pound of supplies used. Freight rates are high, labor is scarce, and correspondingly indifferent; supplies of all classes are commanding the highest prices ever realized. All of these factors increase the difficulty and the expense.

The work on the tunnel has been carried on from four headings. Heading No. 1 leads westward from Gunnison River. It has been in hard rock, which usually requires no timbering, but in places heavy timbering has been necessary. Some beds of very hard rock have been encountered, and from twelve to twenty hours have been required to drill a round of blast holes in the heading. Heading No. 2 leads eastward toward Gunnison River from a shaft located 4,950 feet from the west portal. The ground encountered in this heading has been a blue shale that is usually hard enough to stand temporarily without timbers, but light timbering is necessary to prevent sloughing from the roof and sides. In a number of places small gas seams have been encountered. Over 500 feet of this heading was driven through a remarkable bed of white shells embedded in the shale. So numerous were the shells that the natural strength of the shale was destroyed and greatest care was necessary to prevent injuries to the workmen. Heading No. 3 was driven from the shaft toward the west portal. Prior to April, 1906, the material encountered was hard blue shale similar to that encountered in Heading No. 2. In April, 1906, however, the hard shale was left behind, and since that time the work has been in extremely difficult ground. Heading No. 4 was driven eastward from the west portal. Almost from the start it was an expensive and difficult piece of tunnel work. The material through which the tunnel was driven consisted of adobe mud, gravel beds, sand beds, or some combination of the three.

The natural difficulties encountered have been of an exceptional character. In Heading No. 1 it has been necessary to handle a heavy flow of water, amounting at times to over 700,000 gallons in twenty-four hours. In Heading No. 2 gas-bearing seams have been opened from time to time of sufficient volume to endanger life and property. As this heading has advanced into the mountain there has been a steady rise in temperature. Eighty-five degrees Fahrenheit prevails, except immediately following the blasts, when the temperature rises to 90° F. or higher. This development has taxed the ventilation resources to the utmost. In Headings Nos. 3 and 4 heavy ground and large inflows of water have required unremitting watchfulness and ingenuity to prevent loss and to continue a rational progress.

The progress made in the various headings from August 1, 1905, to June 30, 1906, inclusive, is shown in the table below. (See also Pl. XXV.) Notwithstanding the great difficulties encountered the record of progress is one of unusual excellence. During January, February, and March, 1906, a single gang made the progress shown for Headings Nos. 2 and 3—that is, a single gang made a total advance of 773 feet of tunnel in January, 720 feet in February, and 809 feet in March, or an average progress of about 25.6 feet per day. This is believed to be greater progress than was ever made on similar work.

The work accomplished on all headings in the eleven months ending June 30, 1906, amounted to 11,992 feet or nearly 2¼ miles of tunnel.

Progress made in excavation of Gunnison tunnel.

[Figures indicate linear feet of advance.]

Heading No.	1905.					1906.					
	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.
1	384	358	230	224	82	130	204	240	300	383	373
2	228	439	505	508	608	432	272	272	624	576	624
3	......	......	......	......	......	341	448	537	75	147	120
4	204	162	228	240	228	252	216	210	204	180	204
Total	816	959	963	972	918	1,155	1,140	1,259	1,203	1,286	1,321

Under normal conditions the work should be completed sometime during the year 1908.

SOUTH CANAL.

The south canal (Pls. XXVI and XXVII) is about 12 miles in length and extends from the west portal of the Gunnison tunnel to a point on Uncompahgre River about 9 miles southeast of Montrose. The capacity varies from 1,300 to 1,175 second-feet. The work includes 34,980 feet of earth canal, 21,997 feet of concrete-lined canal, 2,277 feet of tunnel, 14 ten-foot drops, 1 forty-six foot drop (inclined plane), 1 twenty-eight foot drop (inclined plane), 12 pipe culverts, 6 masonry culverts, 3 highway bridges, and 10 diversion pipes, with head-gates, etc. The above enumeration does not include the portal cut at the west end of the Gunnison tunnel, which is 1,900 feet long, and will be lined with concrete.

The canal has been divided into 22 divisions. Nine of these, on which excavation only is necessary and on which lining or structures are not required, were completed between November, 1904, and September, 1905.[a]

On August 28, 1905, bids were received on divisions 10–21, inclusive. The contract for the entire 12 divisions was awarded to Orman & Crook, of Pueblo, Colo. These divisions include all the tunnel work, most of the masonry, and a large amount of excavation. The total estimated price of these 12 divisions is $513,675. On July 1, 1906, the contract was about 34 per cent completed.

On January 3, 1906, a contract was awarded to Western States Portland Cement Company, Independence, Kans., for 2,000 barrels of Portland cement, at $1.45 per barrel f. o. b. Independence. On February 6, 1906, bids were opened for supplying 30,000 barrels of Portland cement, and the contract was awarded to the McPhee & McGinnity Company, at $1.43 per barrel f.o. b. Iola, Kans.

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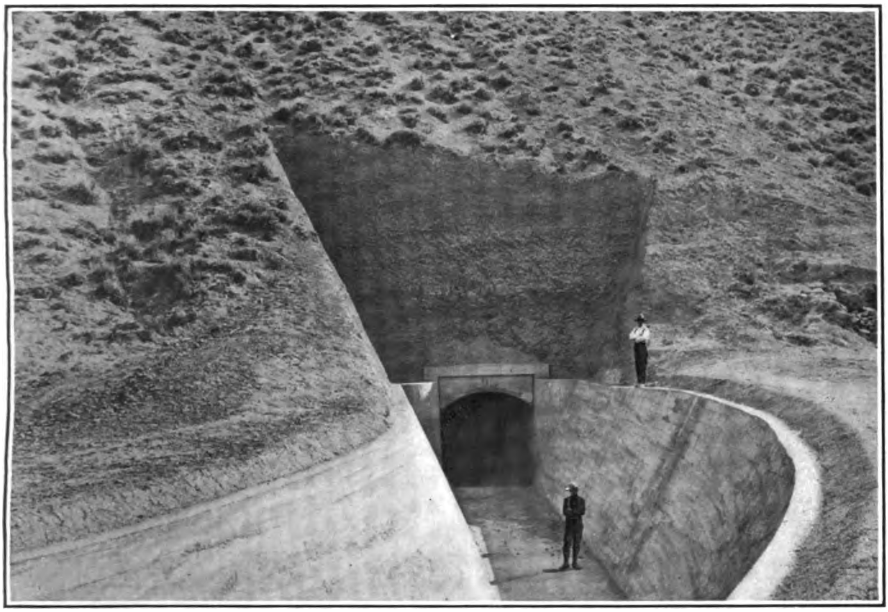
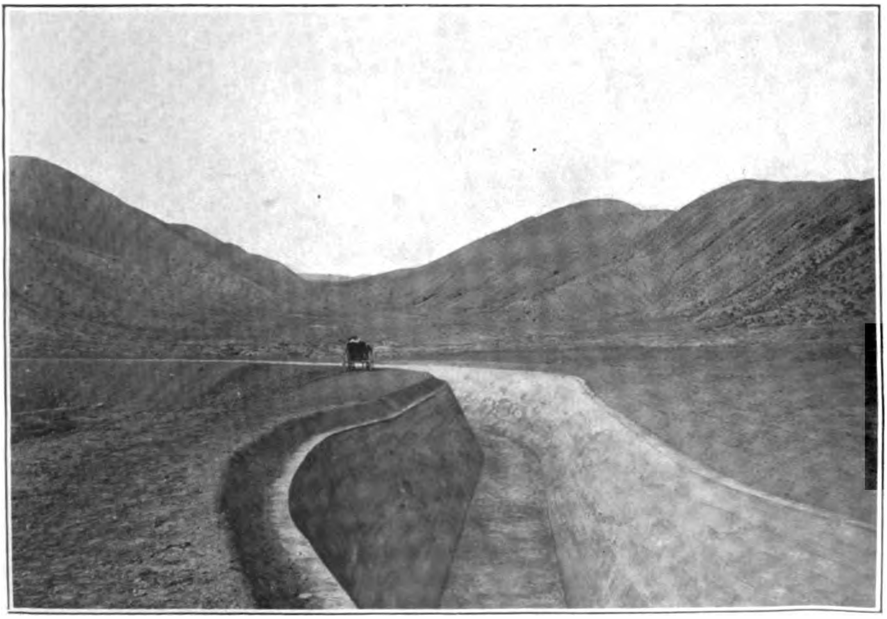
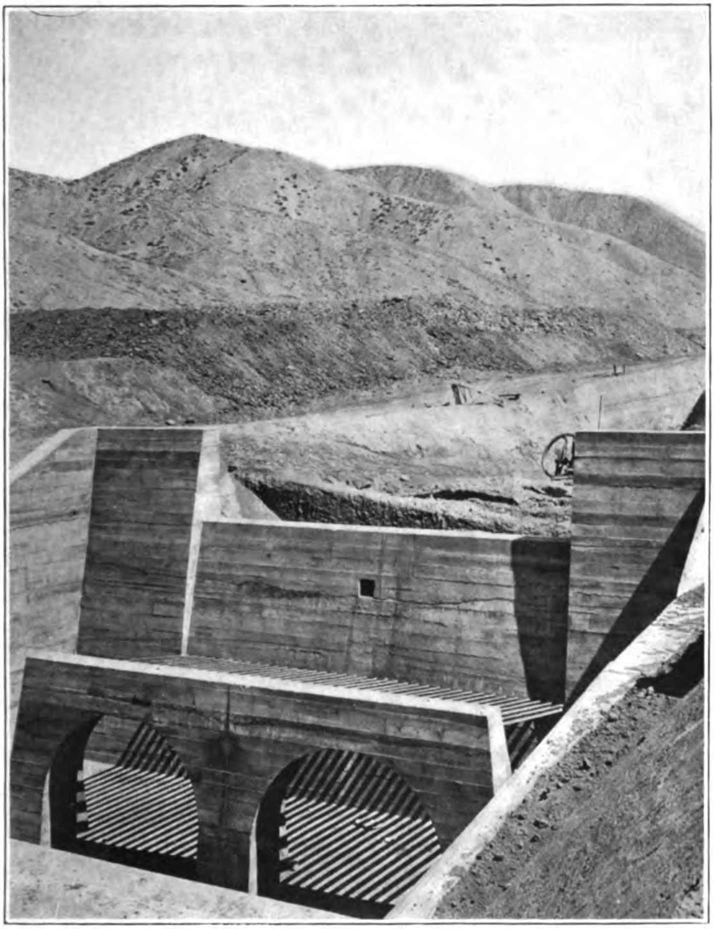
[a] See Third Annual Report, pages 206 and 207, and Fourth Annual Report, page 110.



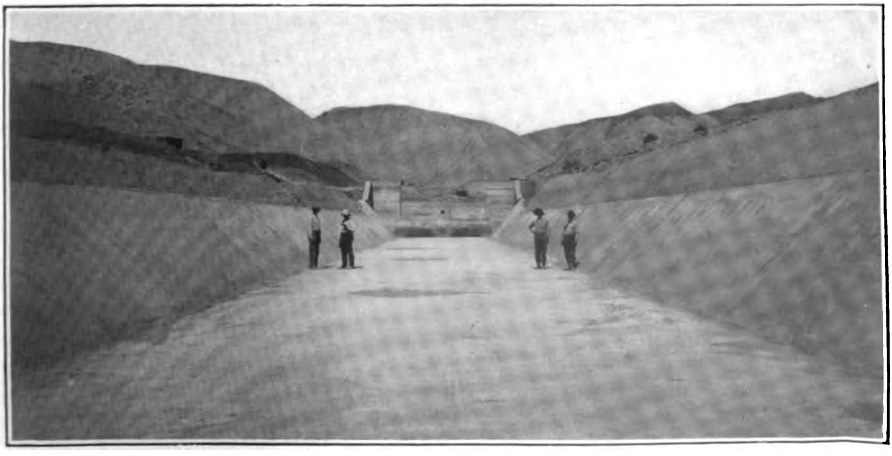
A. EAST PORTAL OF TUNNEL NO. 2 ON SOUTH CANAL, UNCOMPAHGRE VALLEY PROJECT, COLORADO.



B. CONCRETE-LINED SECTION ON SOUTH CANAL, UNCOMPAHGRE VALLEY PROJECT, COLORADO



A. TYPICAL 10-FOOT DROP ON SOUTH CANAL, UNCOMPAHGRE VALLEY PROJECT, COLORADO.



B CONCRETE-LINED SECTION ON SOUTH CANAL, UNCOMPAHGRE VALLEY PROJECT, COLORADO.

Bids opened February 6, 1906, for cement, Uncompahgre Valley project.

[Specifications No. 71.]

Bidder.	Address of bidder.	Brand of cement.	Price per barrel f. o. b. Uncompahgre points.	Price per barrel f. o. b. factory.	Factory located at—	Freight rates per barrel from factory to Uncompahgre Valley points.		Price to Government if purchased f. o. b. factory.
						Published.	Government.	
The Portland Cement Co.	Denver, Colo.	Ideal	$2.90	$1.95	Portland, Colo.	$1.90	$0.95	$2.90
McPhee & McGinnity Co.	do	Iola	3.85	1.43	Iola, Kans.	2.47	1.349	2.779

The contract for two wooden bridges across the canal was awarded to J. B. Elliott and H. E. Dunbar, of Montrose, Colo., on June 20, 1906. These bridges are 90 and 92 feet long, and the prices bid were $138 and $150, respectively. All material will be furnished by the Government. During October and November, 1905, A. S. Bent, of Los Angeles, Cal., constructed 1,724 feet of 24-inch and 920 feet of 36-inch cement pipe to be used as culvert pipe on the canal. The prices paid were 92 cents for the 24-inch pipe and $1.14 for the 36-inch pipe. The cement and water used were supplied by the Government.

EAST CANAL.

The proposed east canal will serve the land lying between the foothills on the east side of the Uncompahgre Valley north of Montrose and the bottom lands along the east bank of Uncompahgre River. Water discharged from the south canal will flow down Uncompahgre River and be diverted by a low dam at a point near the western corner of the town of Montrose. A slough, formerly part of an old bed of the river, about a quarter of a mile from the headworks, affords an economical means of settling out material in suspension.

For 4 miles the canal will run in a northerly direction. It will carry 650 second-feet of water to the first drop, 52 feet in total height, at the bottom of which it will branch. Division 1 will have a capacity of 400 second-feet; it will run westerly and northwesterly along the edge of the north mesa, and then northeasterly across this mesa to a large arroyo, about16 miles from its head. At this point the capacity will be reduced to 217 second-feet, and the canal will then run northerly, and near the twenty-third mile will tail into an arroyo which leads into Gunnison River about 2 miles below the railroad bridge at Cory. Division 2 will run northerly along the base of the hills in the vicinity of the Devils Elbow. Division 2 and the last 4 miles of division 1 are through very rough ground. On the remainder of division 1 the topography is not a serious obstacle. The treacherous nature of the adobe soil found all along the line will necessitate great care in the construction of the embankments and masonry structures. Three large arroyos will be crossed by means of inverted siphons.

WEST CANAL.

The west canal will carry water for the lands west of Uncompahgre River. It extends in a northwesterly direction from a point in the SE. ¼ sec. 36, T. 48 N., R. 9 W., about 7 miles south of the town of Montrose, to Roubideaux Creek, in the SW. ¼ sec. 19, T. 51 N., R. 11 W., a distance of a little more than 31.4 miles.

The headworks are designed to be of steel and concrete, and will be located on the west bank of Uncompahgre River, nearly opposite the point where the south canal discharges the water from the Gunnison tunnel. The capacity of the west canal will be 650 second-feet at the headworks, but it will gradually diminish by successive diversions into the main distributaries, until when the canal finally empties into the Roubideaux the capacity will be only 50 second-feet.

As this canal will follow the broken country lying along the western boundary of the Uncompahgre Valley, numerous creeks and gulches will be crossed and a large amount of side drainage will have to be provided for. It is proposed to cross the larger depressions, such as Happy Canyon and Dry Creek, by inverted siphons, while the drainage from smaller streams will be taken under the canal. All siphons, flumes, culverts, etc., are to be of concrete. In order to avoid building and maintaining a canal along 1½ miles of steep side hill, a tunnel 1,675 feet in length, and having a cross section of 8 by 10 feet, will be driven through the shale ridge between Horsefly and Dolores creeks. The location of the west canal was completed in the fall of 1905. Plans and specifications have been prepared for the portion between Uncompahgre River and Coal Creek, but on account of prevailing high prices for contract work no bids have yet been asked for.

DISTRIBUTION SYSTEM.

In that portion of the Uncompahgre Valley covered by the proposed works of the Reclamation Service there are 110 ditches and laterals, having an aggregate length of something over 475 miles. Forty of these canals carry all of the priority waters of Uncompahgre River, and ten of them carry a little over 70 per cent of the water decreed. Considerably less than one-half of the present ditches can be advantageously incorporated into the larger system contemplated, the others being too small for use except as farm laterals.

In order to remove as far as possible conflicting interests and to avoid burdening the lands with a multiplicity of channels, as well as to reduce the cost of building and operating the irrigation system, efforts are now being made to bring into the project such of the existing canals and ditches as can be beneficially used.

Alternative plans for distributing the water from the main canals to the irrigable lands have been outlined. The first of these includes such of the existing ditches as can be used to advantage, while the other is based on the assumption that an entirely new system is to be built to cover the whole valley so completely that the principal canals now in operation could be abandoned without causing any inconvenience to the water users. The plans of distribution to be finally adopted will, of necessity, depend largely on the result of the negotiations now in progress for the purchase of such of the private ditches as can be profitably incorporated into the project.

IRRIGABLE LANDS.

During the fall and winter of 1905-6 field surveys were made to determine the amount of irrigable and nonirrigable lands under this project. At the same time the public records were examined to ascertain the ownership of the lands to be watered. The result of these investigations are summarized below.

Lands included in Uncompahgre Valley project.

	Acres.	Percentages.
GENERAL SUMMARY.		
Total	181,458	
Private	125,739	69+
Public	55,719	31−
Irrigable	146,886	81−
Nonirrigable	34,572	19+
PRIVATE LAND.		
Total	125,739	
Irrigable	108,500	86+
Nonirrigable	17,239	14−
PUBLIC LAND.		
Total	55,719	
Irrigable	38,386	69−
Nonirrigable	17,333	31+
IRRIGABLE LAND.		
Total	146,886	
In Montrose County	99,916	68+
In Delta County	46,970	32−
East of Uncompahgre River	76,956	52+
West of Uncompahgre River	69,930	48−
Bottom land, Uncompahgre River	7,000	05−
Bottom land, Gunnison River	3,600	02+
Under existing canals	124,416	85−
Above existing canals	22,470	15+
Requiring siphons	4,300	03−
IRRIGABLE LAND—continued.		
Public	38,386	26+
Private	108,500	74−
Subscribed (private)	92,045	63−
Unsubscribed (private)	16,455	11+
NONIRRIGABLE LAND.		
Total	34,572	
Public	17,339	50+
Private	17,239	50−
In Montrose County	27,072	78+
In Delta County	7,500	22
LAND IN MONTROSE COUNTY.		
Total	126,988	
Private	93,213	73+
Public	33,775	27−
Irrigable	99,916	79−
Nonirrigable	27,072	21+
LAND IN DELTA COUNTY.		
Total	54,470	
Private	32,526	60−
Public	21,944	40+
Irrigable	49,970	68+
Nonirrigable	7,500	15−

EXPENDITURES.

The expenditures on the Uncompahgre Valley project are summarized in the following tables:

Expenditures according to physical features on Uncompahgre Valley project to June 30, 1906.

Feature.	Engineering and administration.	Building.
Incidental structures:		
Road west to east portal, 10 miles	$2,977.12	$19,580.10
Telephone line, 24 miles	483.73	5,961.72
Steam and electric power plant, east portal		56,000.00
Steam and electric power plant, west portal		83,000.00
Machine shop, east portal		4,000.00
Machine shop, west portal		7,000.00
Montrose office building	316,11	6,006.23
Montrose barns, corrals		3,623.34
Tunnel offices, hospitals, etc		6,703.86
Tunnel cottages, lodging and boarding houses		20,111.59
Tunnel warehouses and corrals		6,703.86
Irrigation structures:		
Gunnison tunnel		691,301.51
South canal, including tunnels, drops, etc	6,025.96	222,148.00
East canal	11,555.67	
West canal	16,388.68	
Distributing system	309.35	
Irrigable lands:		
Farm unit subdivision and soil examination	3,264.55	
Examination of project as a whole	91,768.57	
Administration of project as a whole	52,819.20	
Total	185,908.94	1,132,140.21
Grand total		1,318,049.15

Expenditures, according to purpose and nature, on Uncompahgre Valley project to June 30, 1906.

[Total, $1,318,049.15]

	Services.	Traveling.	Subsistence.	Equipment.	Materials.	Supplies.	Rent and storage.	Forage.	Job work.
Engineering:									
Examination	$4,600.20	$540.55	$1,001.14	$217.10	....	$489.95	$127.96	$136.34	....
Survey and inspection...	64,318.69	5,929.54	16,206.09	13,515.25	....	7,826.02	1,196.87	2,548.73	....
Design........	7,160.05	511.75	639.27	790.86	....	854.13	147.51	124.69	....
Subdivision...	3,327.30	201.81	95.92	166.64	....	239.64	38.78	136.96	....
Building:									
Rights and property....	300.00	84.57	....	....	....	....	....	....	....
Building......	539,018.38	2,201.40	12,875.45	79,221.55	$48,599.45	209,668.77	326.53	11,785.12	$228,058.99
Administration.	35,222.11	3,877.38	1,231.19	4,746.86	....	5,994.42	1,049.75	697.49	....

PROPOSED GRAND VALLEY PROJECT.

No work has been done on the proposed Grand River project during the last fiscal year. The condition of the reclamation fund did not warrant the allotment of a large sum for work in this area. A water users' association has been organized by the residents of the valley and the conditions are such that a final investigation can easily be made whenever the necessary funds are available. A summary of the expenditures is given in the following table:

Expenditures, according to purpose and nature, on proposed Grand River project to June 30, 1906.

[Total, $8,712.20.]

	Services.	Traveling.	Subsistence.	Equipment.	Supplies.	Rent and storage.	Forage.
Engineering:							
Examination.....	$3,105.87	$354.70	$1,246.94	$708.49	$665.07	....	$255.06
Survey...........	971.13	108.92	....	....	23.82	....	....
Design...........	95.27	....	....	9.53	....	....	....
Administration......	601.77	61.67	236.13	93.01	113.13	$33.35	28.34

COLORADO RIVER STORAGE.

The Fourth Annual Report contains a description of the work done on reservoir sites in Colorado in connection with the study of methods of conserving the water supply in the Colorado River basin. The field work in connection with these storage reservoirs was brought to a close late in 1905 and no additional examinations have been made since those described in the Fourth Annual Report. The expenditures for this work are summarized in the following table:

Expenditure, according to purpose and nature, on proposed Colorado River storage project to June 30, 1906.

[Total, $17,913.09.]

	Services.	Traveling.	Subsistence.	Equipment.	Supplies.	Rent and storage.	Forage.
Engineering:							
Examination.....	$7,729.36	$1,680.52	$1,535.34	$1,345.90	$613.27	$350.92	$1,264.74
Survey...........	121.00	216.93	....	836.99	19.96	....	11.00
Design...........	47.63	....	....	4.76	11.91	....	....
Administration......	1,886.68	15.51	24.79	87.09	59.04	28.00	21.75

PROPOSED WHITE RIVER PROJECT.

No surveys have been made in connection with the White River project since June, 1904. The practicability of this project from the financial standpoint is very doubtful, although when land becomes more valuable in this region the project may be considered feasible. A summary of the expenditures is given in the following table:

Expenditures, according to purpose and nature, on proposed White River project to June 30, 1906.

[Total $3,855.79.]

	Services.	Traveling.	Subsistence.	Equipment.	Supplies.	Rent and storage.	Forage.
Engineering:							
Examination	$1,960.53	$149.21	$500.30	$286.06	$273.57	$3.41	$141.04
Design	95.28	....	....	9.52	23.82	....	....
Administration	178.48	21.43	55.58	45.87	66.98	33.34	11.37

IDAHO.

MINIDOKA PROJECT.

GENERAL STATEMENT.

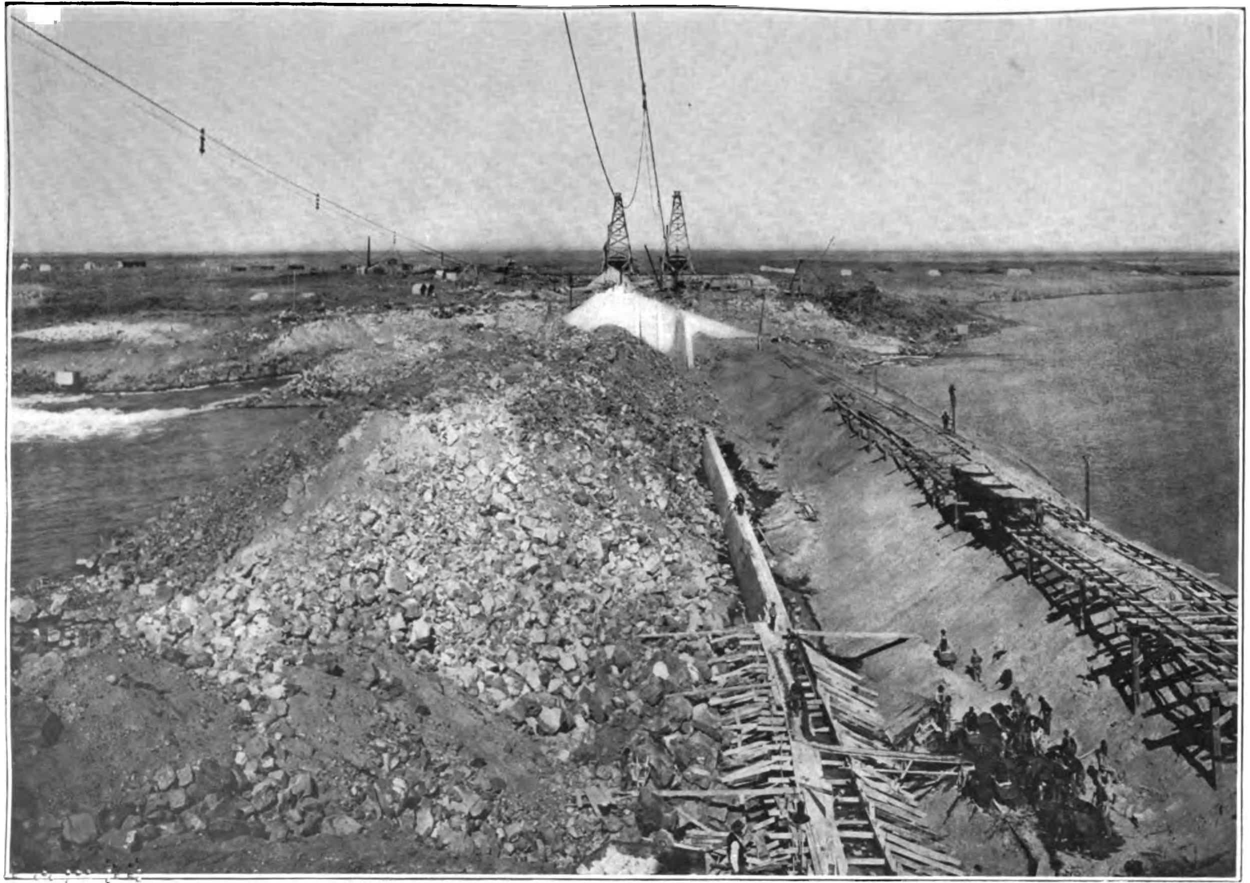
The general features of the Minidoka project are summarized below:

Summary of principal data relating to Minidoka project.

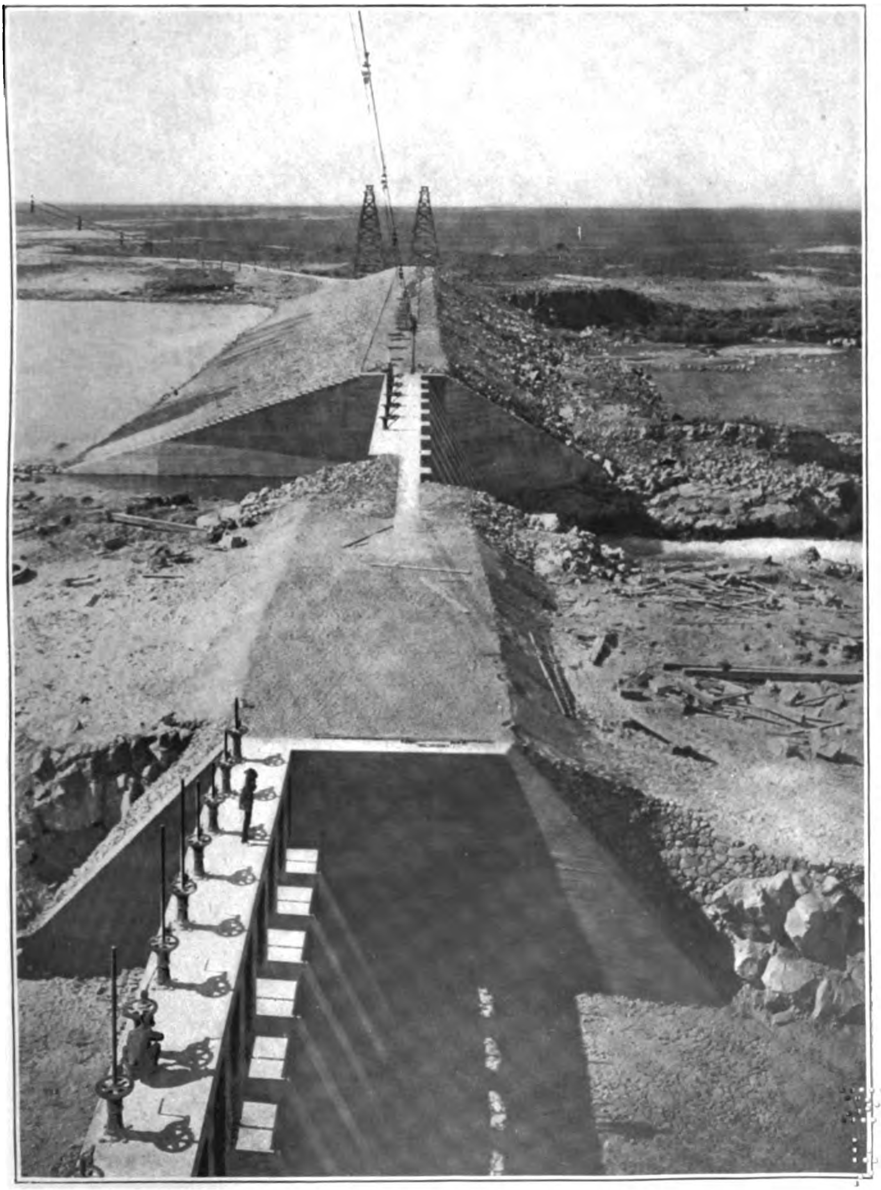
Counties: Lincoln and Cassia.
Latitude: 42° 11′.
Longitude: 113° 30′.
Townships: Townships 8 to 10 south, ranges 22–25 E. B. M.
Irrigable area: 130,000 to 150,000 acres.
Watershed area: 17,900 square miles.
Average rainfall: 15 to 19 inches.
Estimated run-off: 0.512 second-foot per square mile, or depth in inches 6.9; 5,000,000 to 8,000,000 acre-feet.
Range of temperature: Maximum 96°, minimum 12°, mean 45°.
Average elevation: 4,200 feet.
Principal products: Alfalfa, 2 to 3 crops; sugar beets, cereals, vegetables.
Nearest railroad: Minidoka and Southwestern Railroad, connecting with Oregon Short Line.
Nearest stations: Rupert, Heyburn, Burley.
Principal market: Local mines.
Kind of headworks: Storage reservoirs on South Fork Snake River and Diversion dam.
Capacity of reservoirs: 732,400 acre-feet.
Duty of water: Estimated average 4 feet deep, measured at point of diversion.
Type of diversion dam: Rock fill.
Length of diversion dam: 600 feet.
Length of canals: 130 miles.
Length of laterals: 110 miles.
Power developed: 11,000 to 30,000 horsepower.
Ownership of lands: 25,000 State, balance public.
Character of soil: Sandy loam.
Value of irrigated land: $50 to $100.
Beginning of survey: March, 1903.
Date of completion: May, 1907.

The Minidoka project provides for the reclamation of from 130,000 to 150,000 acres in the central portion of the Snake River Valley. Water is diverted from Snake River and carried by gravity to about 80,000 acres, about 72,000 of which are on the north side of the river and 8,000 on the south side. From 50,000 to 70,000 acres of very desirable land are situated above the gravity canals, and it will be feasible to pump water to these lands at some future time. The diversion works now being constructed have been planned to provide facilities for this purpose.

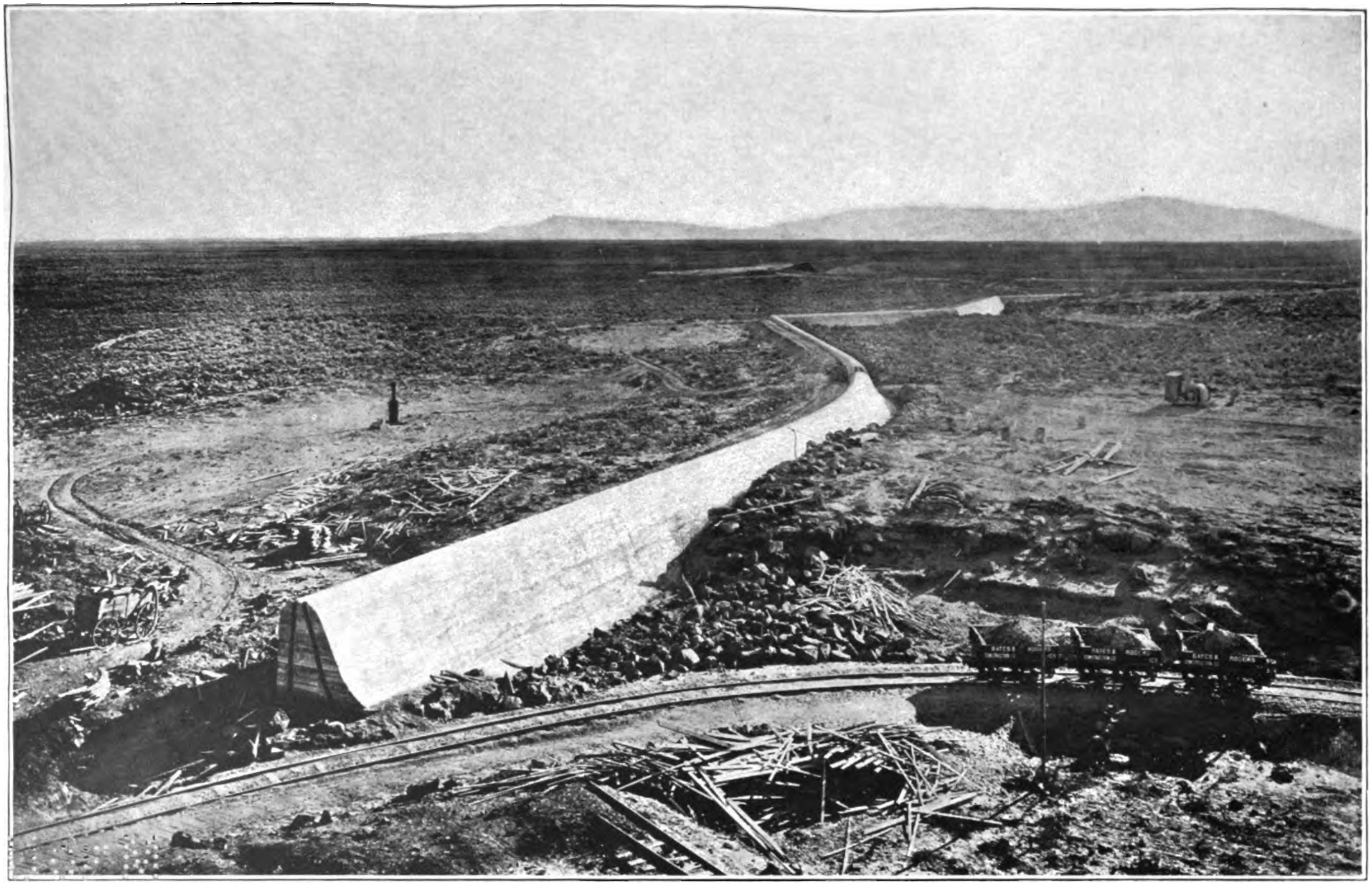
The preliminary work necessary on this project included the erection of office buildings, lodging houses, warehouses, and corrals, and the installation of a telephone system. The telephone line will not cease



MINIDOKA DAM, MINIDOKA PROJECT, IDAHO, FROM THE SOUTH SIDE, APRIL 8, 1906.



THE MINIDOKA DAM, REGULATING WORKS AND HEADWORKS OF MAIN CANAL, MINIDOKA PROJECT, IDAHO, FROM THE NORTH SIDE, AUGUST 29, 1906



SPILLWAY ON SOUTH SIDE OF MINIDOKA DAM, MINIDOKA PROJECT, IDAHO, OCTOBER 30, 1905.

to be of value when the project is completed, as it is a necessary adjunct to the proper operation of the works.

In the following table are listed the contracts entered into for building work on the Minidoka project. This list includes all contracts for excavation, embankment, masonry, and erection of structures, but does not include materials such as cement, steel, timber, etc.

Contracts for building work on Minidoka project to June 30, 1906.

No. of contract.	Contractor.	Feature.	Estimated total value.[a]	Payments to June 30, 1906.	Per cent paid.
17	Bates & Rogers Construction Co.	Dam, spillway, etc	$425,923	$292,373.88	69
52	W. H. Crumb & Co	Telephone	6,335	6,791.47	100
53	Orman & Crook	Main canal, divisions 1, 5 to 7.	354,823	304,593.12	86
54	Hubbard & Carlson	Main canal, division 2	121,494	101,890.67	84
55	Monarch & Porter	Main canal, divisions 3, 4	194,827	78,749.74	40
56	Vulcan Iron Works	Main canal, division 8	9,471	4,228.63	45

[a] For a discussion of advance estimates and final costs see p. 51.

DAM AND SPILLWAY.

The dam by which water is to be diverted from Snake River is of the rock-fill type with earth and gravel back filling and concrete abutments, cut-off, and core walls (Pls. XXVIII–XXXIV). A solid concrete dam with five 8 by 12 foot regulating gates is placed in the diversion channel through which Snake River was discharged after the channel was closed by the rock fill. A full description of the dam, spillway, and regulating gates is given in the Fourth Annual Report and detail drawings in the Third Annual Report, Pls. XXI and XXII.

A contract was let September 17, 1904, to the Bates & Rogers Construction Company for building the dam, spillway, diversion channel, regulating gates, and head gates, and work was begun during the following October. The contract provided for its completion by December 17, 1905; but as delay in awarding this contract prevented the contractors from taking full advantage of the low stage of water during the fall of 1904, and as the weather was inclement during the winter of 1905–6, an extension was asked for and granted to July 1, 1906.

The channel of Snake River was closed by the rock fill in April, 1906, and the entire flow of Snake River discharged through the regulating gates. The flood flow of this stream was somewhat above normal, the maximum discharge at this point amounting to 24,290 second-feet, occurring June 20, 1906. The unusually cold weather that prevailed during all of March and at intervals throughout April, May, and June tended to check the spring and summer floods, which was greatly to the advantage of the contractors. It was fully expected that the river would discharge over the spillway during its high-water stage, but it rose only to within 3.2 feet of the crest of the weir. Before this stage was reached the rock fill was raised to its maximum height, which is 13.2 feet above the highest level reached by the river. At this level the water passed freely through the rock fill, the leakage being estimated at about 1,000 second-feet, which was evenly discharged throughout the length of the dam. A track was laid on top of the rock-fill and the gravel and earth for back filling side dumped from cars into the water. At first a comparatively large percentage of this material was carried into the rock fill, but the interstices were soon filled and the water completely shut off. The entire loose rock fill was made water-tight under these conditions. Since the maximum height of the water will be only about 7 feet above the highest level reached during the process of back filling, it is believed there will be but little if any settlement in the dam and back filling and practically no seepage. The water in the river began falling before the end of June, and there will be no further danger of delay from high water.

MAIN CANALS.

Work by Orman & Crook, Hubbard & Carlson, and Monarch & Porter, under contracts entered into in July and August, 1905, for the excavation of the main canals and distributing system, has been in progress. A detailed description of these canals is given in the Fourth Annual Report, pages 135 and 136. Very satisfactory progress was made by Orman & Crook and by Hubbard & Carlson, but progress by Monarch & Porter has been very slow. All of the grading contracts provide for the completion of the work by June 1, 1906, but owing to the long-continued spell of cold weather during last winter all of these contracts were extended to July 1. Orman & Crook's contract provides for excavating the main north and south side canals and a waste canal, and building the bridges and structures on the main canals and branches. Ninety-six per cent of the grading was completed under Orman & Crook's contract at the close of the fiscal year. Practically none of the masonry work, however, was done.

Work under the Hubbard & Carlson contract has been vigorously pushed from its inception, and at the close of the fiscal year 94 per cent was completed.

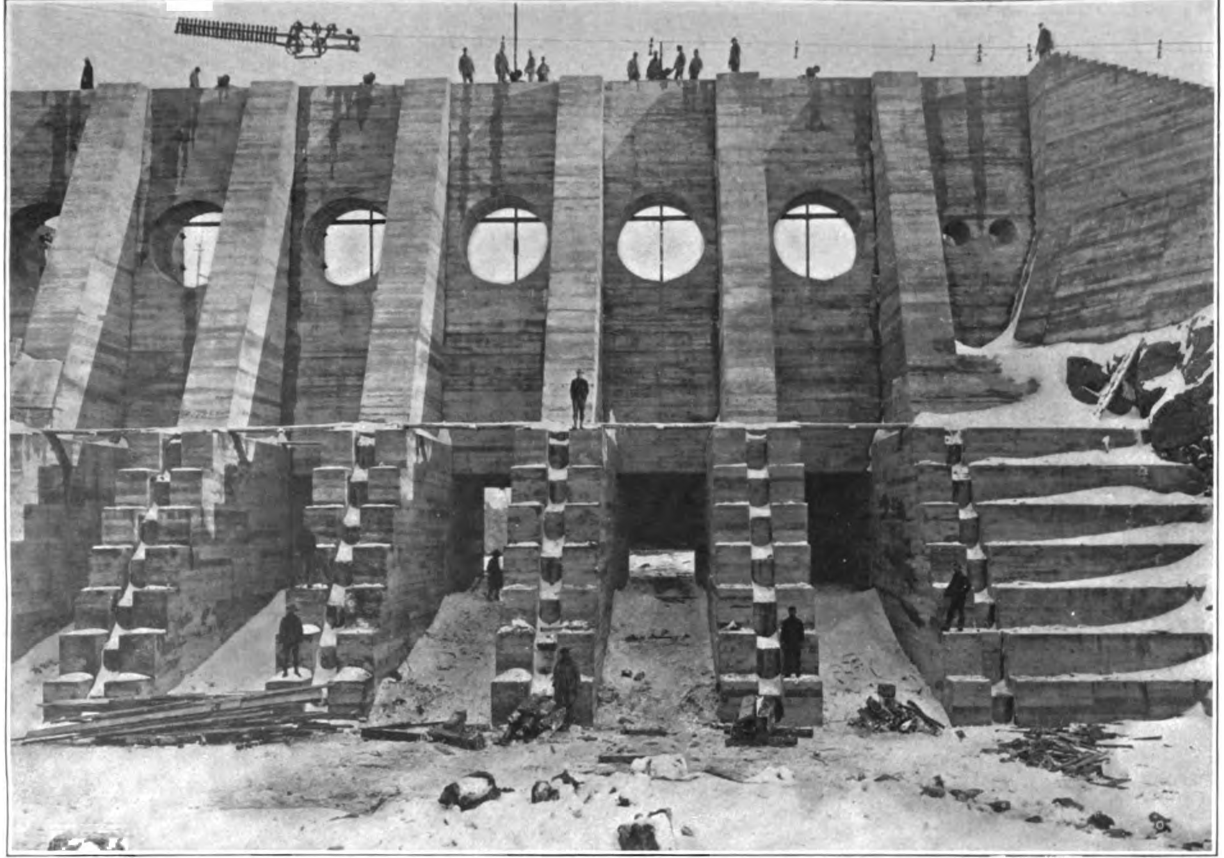
Only 28 per cent of the work under Monarch & Porter's contract was completed on March 1. At the rate of progress then being made, the work would not be completd before January 1, 1907, but in March the bondsmen assumed the management. The force was greatly increased and work so vigorously prosecuted that 50 per cent was completed by June 30. The canal will be ready for the distribution of water during the season of 1907.

All of the cement, 20,000 barrels, contracted to be furnished by the Portland Cement Company of Utah was delivered by the close of the fiscal year. Both the delivery and quality of this cement were very satisfactory.

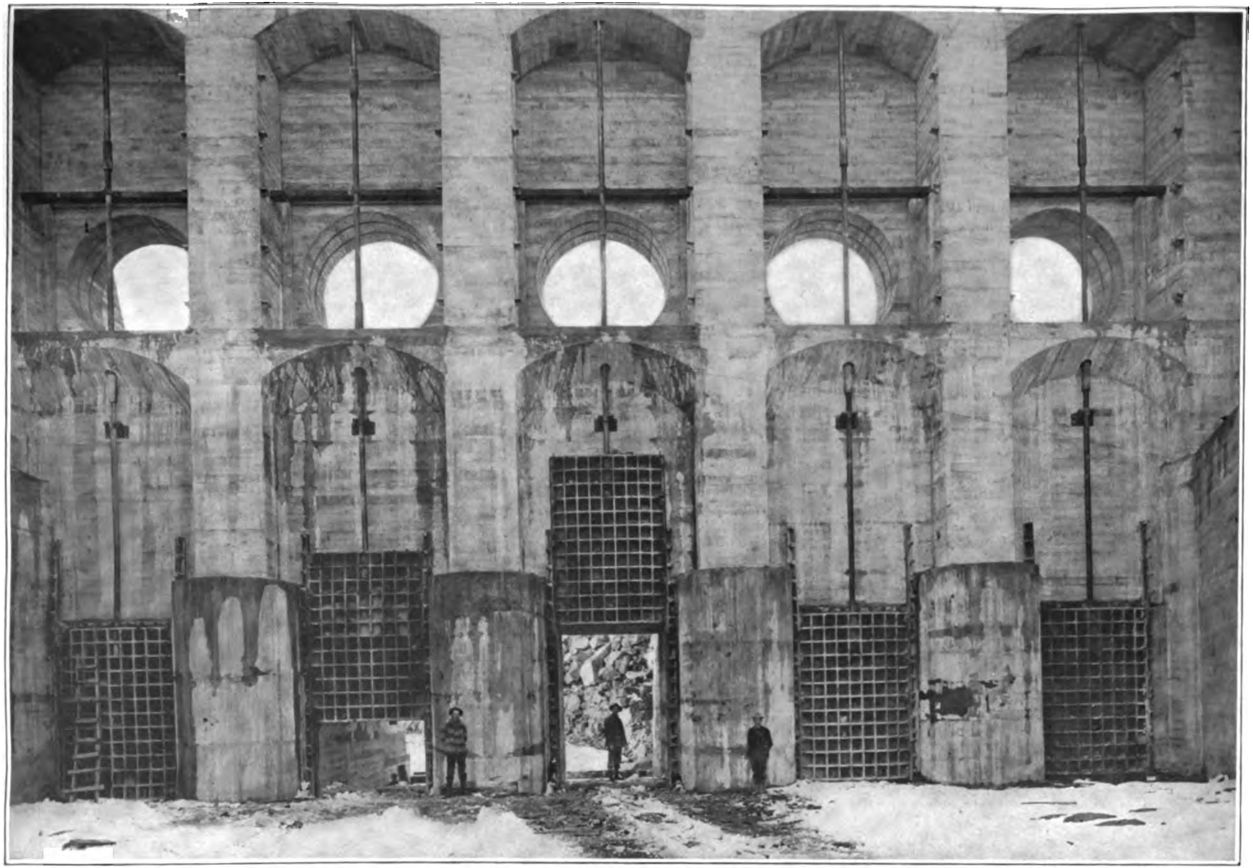
Of the gates and lifting devices furnished by the Vulcan Iron Works of Chicago 55 per cent was delivered by June 30, 1906. The remainder of the material to be furnished under this contract will be received before it will be necessary to place it in the structures.

DISTRIBUTION SYSTEM.

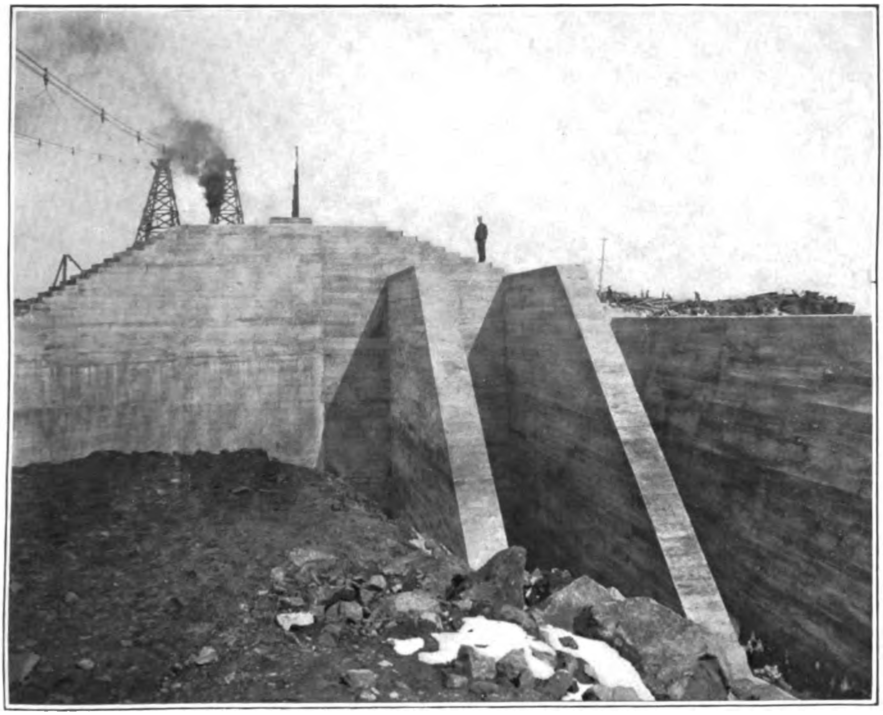
During the spring and summer of 1906 the farm unit lateral system was laid out. These laterals will vary in capacity from 4 to 25 second-feet and in length from one-half mile to 4 miles, the total



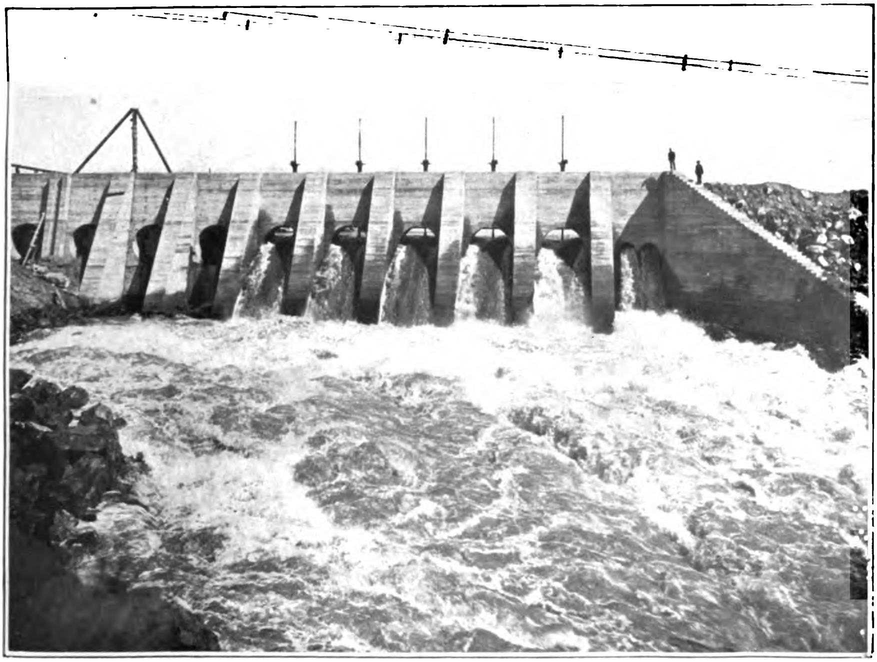
DOWNSTREAM FACE OF CONTROLLING WORKS IN DIVERSION CHANNEL, MINIDOKA DAM, MINIDOKA PROJECT, IDAHO, SHOWING COMPLETED WORK, MARCH 1, 1906.



UPSTREAM FACE OF CONTROLLING WORKS IN DIVERSION CHANNEL, MINIDOKA DAM, MINIDOKA PROJECT, IDAHO, SHOWING THE FIVE 8 BY 12 FEET COFFIN GATES IN POSITION, MARCH 1, 1906.

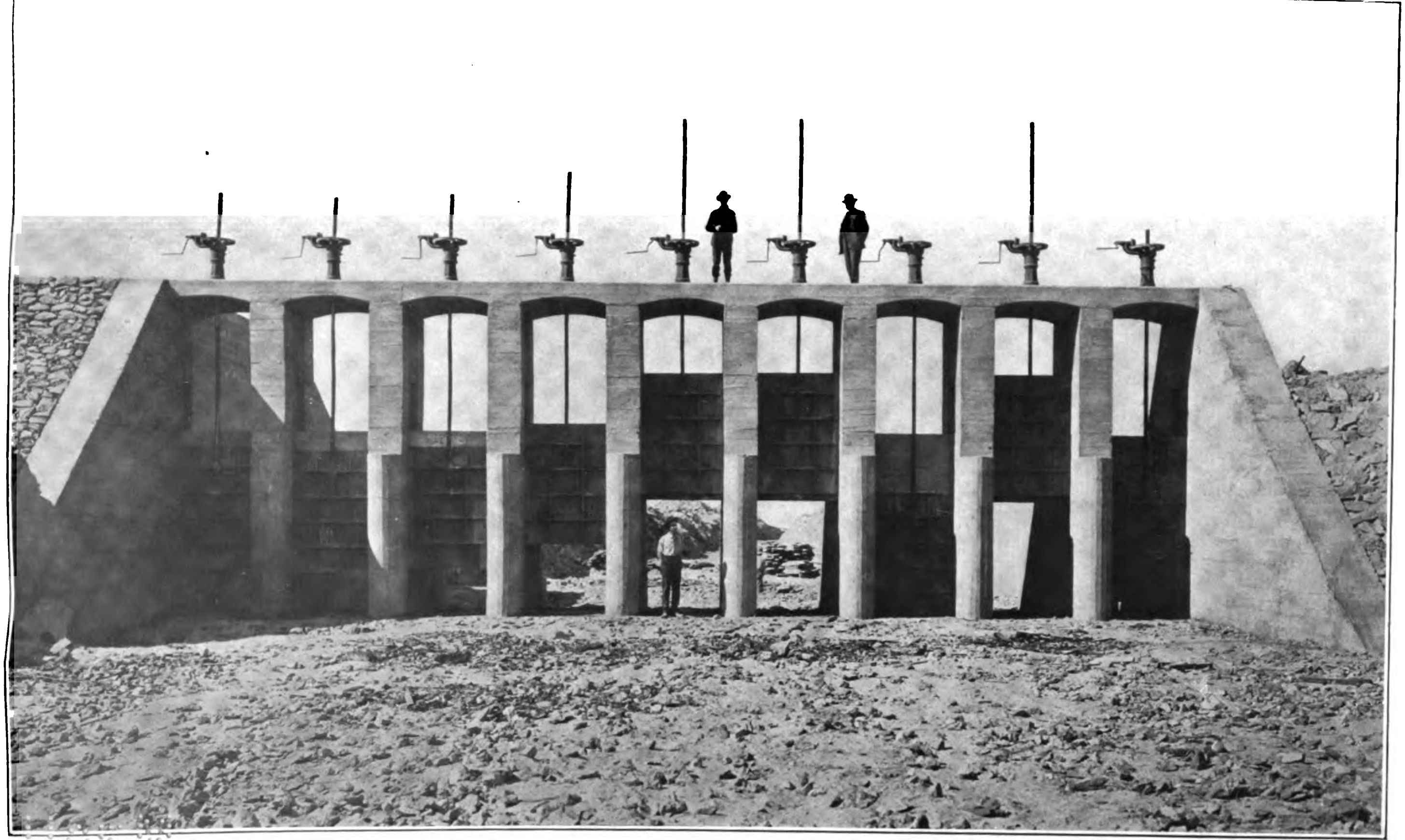


A. CUT-OFF AND CORE WALLS, NORTH END OF MINIDOKA DAM, MINIDOKA PROJECT, IDAHO, MARCH 6, 1906



B. DOWNSTREAM VIEW OF CONTROLLING WORKS IN DIVERSION CHANNEL, MINIDOKA DAM, MINIDOKA PROJECT, IDAHO.

Showing the entire flow of Snake River, about 22,000 cubic feet per second, passing through gates and penstock openings, June 2, 1906.



UPSTREAM FACE OF HEADWORKS OF MAIN NORTH SIDE CANAL, MINIDOKA PROJECT, IDAHO, SEPTEMBER 28, 1906.

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length being about 140 miles. About 600,000 yards of earth will have to be excavated. The laterals have been located with a view to delivering water to each farm unit under the gravity system. The capacity of these small ditches is based upon the delivery of 1 second-foot for each 40 acres. No lateral, however, is to have a capacity of less than 4 second-feet. Many long low embankments will have to be constructed in building these small ditches. Owing to the character of this work, the varying dimensions of the ditches, and the importance of having them well constructed it has been decided to do the work by force account. In order not to interfere with the plans of the contractors as they relate to the employment of labor, work on the lateral system will not be undertaken, however, until practically all of the work under the grading contracts has been completed.

TOWN SITES.

Surveys of the town sites of Rupert and Heyburn were completed by the United States General Land Office in November, 1905. The opening to settlement of these town sites has, however, been delayed pending the passage by Congress of a measure providing for the withdrawal of land for town-site purposes under irrigation projects. A general measure for this purpose was approved April 16, 1906, but was later amended by a bill which provided a method for the disposal of lots in the town sites of Rupert and Heyburn on which improvements had been placed by the settlers. It is expected that a board of appraisers will soon be appointed and dates set for the sale of lots in these town sites.

JACKSON LAKE RESERVOIR.

Investigations preparatory to building regulating works at the outlet of Jackson Lake, Wyoming, were begun during the latter part of June, 1906. This lake is situated on the South Fork of Snake River, and it is proposed to utilize it for storage purposes. It is proposed to build a temporary dam near the outlet of the lake and raise the surface of the water 10 or 15 feet. This dam will consist of cribs constructed of logs and filled with gravel. The reservoir will have a capacity of from 250,000 to 350,000 acre-feet, enough to supply the demand for the next six or seven years. The most feasible location for a permanent dam seems to be just below the mouth of Pacific Creek, about 4 miles below the outlet of the lake. A 40-foot dam at this point would raise the lake surface 30 feet and would provide a reservoir having a capacity of from 800,000 to 1,000,000 acre-feet. By locating the controlling works at this point the discharge of Pacific Creek could be stored. Timber suitable for the construction of the temporary dam was selected and bids received for cutting and delivering the same—about 370,000 feet B. M.—at the outlet of the lake.

An examination was made of the damages which would likely be done to property in the vicinity by building the temporary as well as the permanent works, and arrangement made for appraising the same. It has been decided to do this work by force account, since the character of the work itself, the shortness of the season, and the remoteness of the site from railroad points would not tend to make it inviting to contractors.

RIGHT OF WAY.

Negotiations for the purchase of lands that will be submerged by the backwater of the Minidoka dam have progressed favorably and arrangements have been concluded with practically all of the landowners. The following purchases have been made and agreements entered into:

Agreements for purchase of right of way above Minidoka dam.

Name.	Date of agreement.	Length of option.	Date agreement expires.	Number of acres.	Price paid.
		Months.			
Geo. W. Hall	Feb. 1, 1906	6	Aug. —, 1906	175.2	$5,500
Liberty I. Hunt	Feb. 24, 1906	11	Aug. 24, 1906	....	1,400
Andrew H. Smith	Oct. 22, 1904	6	Apr. 22, 1905	158.7	1,900
Gifford Samson	Oct. 21, 1904	11	Apr. 21, 1905	428.7	13,160

IRRIGABLE LANDS.

The distribution of the irrigable lands under the Minidoka project is shown by the following table:

Lands included in Minidoka project.

	Acres.	Percentages.		Acres.	Percentages.
GENERAL.			NONIRRIGABLE.		
Total	86,575	100	Total	7,314	100
Government	79,603	92−	North of Snake River	7,314	100
State	6,738	8−	South of Snake River	0	0
Deeded	234	0+	Government	7,022	96+
Irrigable	79,261	92−	State	288	4−
Nonirrigable [a]	7,314	8+	Deeded	4	0+
GOVERNMENT.			IN LINCOLN COUNTY.		
Total	79,603	100			
Irrigable	72,581	91+	Total	78,661	100
Nonirrigable	7,022	9−	Government	74,306	94+
			State	4,279	5+
STATE.			Deeded	76	0+
Total	6,738	100	Irrigable	71,347	91−
Irrigable	6,450	96−	Nonirrigable	7,314	9+
Nonirrigable	288	4+			
			IN CASSIA COUNTY.		
IRRIGABLE.					
Total	79,261	100	Total	7,914	100
			Government	5,296	67−
North of Snake River (Lincoln County)	71,347	90+	State	2,459	31+
			Deeded	159	2+
South of Snake River (Cassia County)	7,914	10−	Irrigable [b]	7.914	100
Government	72,581	92−	Nonirrigable	0	0
State	6,450	8+			
Deeded	230	0+			

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[a] The nonirrigable lands consist of sand dunes and knolls varying from less than an acre to several acres in area and from 1 to 10 feet above the gravity canal. Many of these will be leveled off and cultivated.

[b] In Cassia County (south of Snake River) all of the land in the given area lies below the gravity canal and is irrigable.

EXPENDITURES.

The expenditures on the Minidoka project are summarized in the following tables:

Expenditures, according to physical features, on Minidoka project to June 30, 1906.

Features.	Engineering and administration.	Building.
Incidental structures:		
Telephone line, 18 miles	$1,307.00	$6,791.00
Headquarters—		
Offices	300.00	4,500.00
Cottages and boarding and lodging houses		
Warehouses, corrals, etc		
Irrigation structures:		
Temporary dam, Jackson Lake	373.00	230.00
Minidoka reservoir—lands submerged	2,806.00	15,060.00
Minidoka dam, spillway, diversion channel, etc	19,938.00	339,253.32
Main north and south canals	15,040.00	280,352.50
Main canal structures	3,408.00	16,402.00
Distribution system	24,223.00	175,026.83
Irrigable lands:		
Farm and subdivision and soil examination	1,373.49	....
Examination of project as a whole	28,919.38	....
Administration of project as a whole	26,503.12	....
Total	124,190.99	837,615.65
Grand total	....	961,806.64

Expenditures, according to purpose and nature, on Minidoka project to June 30, 1906.

[Total, $961,806.64.]

	Services.	Traveling.	Subsistence.	Equipment.	Materials.	Supplies.	Rent and storage.	Forage.	Job work.
Engineering:									
Examination	$21,963.03	$2,589.01	$2,322.63	$2,182.41	....	$1,228.06	$461.22	$230.27	....
Survey and inspection	30,703.43	3,215.23	6,216.32	12,969.53	$551.36	2,547.33	73.78	1,791.22	....
Design	6,155.77	556.60	79.07	267.02	....	197.43	13.66	....	....
Subdivision	961.34	204.13	....	104.97	....	89.39	13.66	....	....
Building:									
Rights and property	1,887.74	64.85	342.22	30.80	13,160.00	1,986.37	....	40.45	....
Building	44,791.88	1,862.85	7,178.94	3,394.05	44,406.35	4,664.88	4.50	3,016.44	$710,783.33
Administration	18,866.62	1,761.26	....	1,989.35	....	3,084.29	801.60	....	....

PAYETTE-BOISE PROJECT.

GENERAL STATEMENT.

A general summary of the main features of the Payette-Boise project is given below:

Summary of principal data relating to Payette-Boise project.

Counties: Ada, Canyon, and Owyhee.
Latitude: 43°, 44°.
Longitude: 116°.
Townships: 1 to 10 north; Ranges: 1 to 5 west, 1 to 2 east.
Irrigable area: 372,000 acres.
Watershed area: 6,000 square miles.
Average rainfall: 14.5 inches.
Estimated run-off: 1.2 second-feet per square mile.
Depth of run-off in inches per square mile: 16.1.
Range of temperature: Maximum, 104°; minimum, 9°; mean, 56.6°.
Average elevation: 2,250 to 2,800 feet.

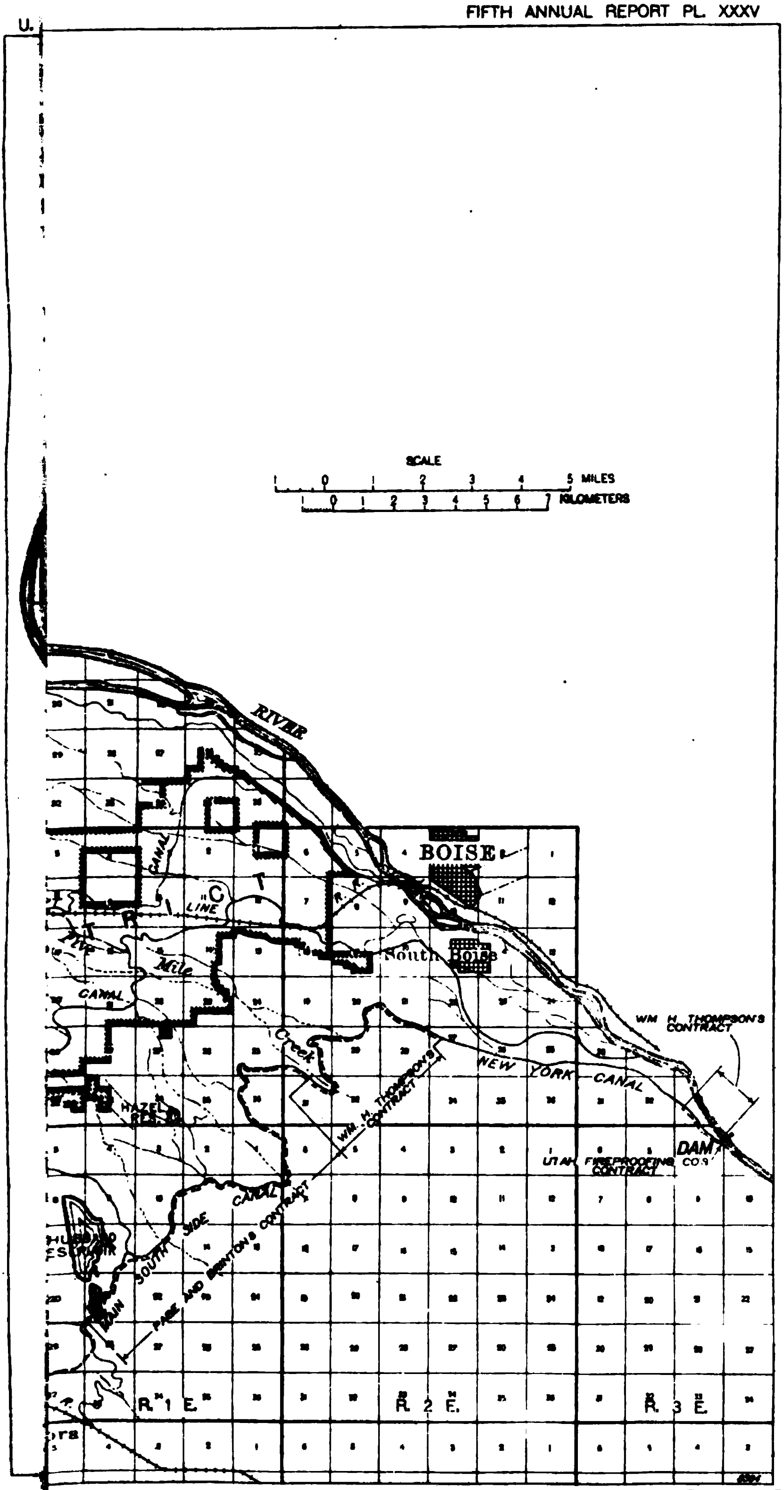
Principal products: Alfalfa, sugar beets, apples, prunes, etc.
Nearest railroads: Oregon Short Line; Boise, Nampa and Oregon; Idaho Northern.
Nearest stations: Payette, Nampa, Boise, Meridian, Caldwell.
Principal markets: Local mines, Portland, Oreg., and eastern cities for fruit.
Kind of headworks: Masonry diversion dams.
Reservoir area: 9 reservoirs—capacity, 367,500 acre-feet.
Duty of water: Average depth, 4 feet, measured at head gates of main canals.
Height of dams: Payette dam, 100 feet; Boise dam, 33 feet.
Length of dams: Payette dam, 400 feet; Boise dam, 400 feet.
Type of dam: Payette, rock fill; Boise, masonry.
Length of canals: 200 miles.
Length of laterals: 100 miles.
Power developed: 12,500 horsepower, transmitted 29 miles; 15,000 acres to be watered by pumping; lift, 50–90 feet; 3,000 horsepower required.
Tunnels: 1 in earth south side Payette canal, 1,100 feet long.
Per cent public land: 25.
Character of soil: Light sandy loam.
Value of irrigated land: $50 to $150 per acre.
Date of completion: First division, March 1, 1908.

The Payette-Boise project (Pl. XXV) provides for the reclamation of 372,000 acres of land situated in the Boise and Payette valleys, 300,000 of which are in a desert condition.

The project contains four natural subdivisions: (1) The Payette division, comprising lands of the Payette Valley and the area in the Boise Valley that can be irrigated by the waters of Payette River, amounting to 72,000 acres, 60,000 of which are desert and 12,000 under cultivation; (2) the north side Boise division, comprising lands lying on the north side of Boise River below the level of the Farmers' Union Canal and its extension, containing an area of 33,000 acres, 25,000 of which are desert, the remaining 8,000 being under cultivation; (3) the south side Boise division, comprising lands on the south side of the Boise Valley that are to receive water from the Boise River, embracing an area of 272,000 acres, 109,000 of which are irrigated or are provided with canals of sufficient capacity for their irrigation; and (4) the Succor Creek division, consisting of the lands on the south side of Snake River near the Idaho-Oregon State line in the vicinity of Succor Creek, containing an area of 25,700 acres, all of which is in a desert condition. It is estimated that about 10,000 acres of this area could be irrigated by means of the surplus flow of Succor Creek which would be impounded in reservoirs located on that stream, and 15,700 acres which border Snake River could be reclaimed by pumping, the power to be furnished at the dam to be built at the head of the canal on Payette River.

About 6 miles above the town of Emmett a dam will be built in Payette River, designed to raise the water level about 80 feet. A canal will divert from this dam on the south side of the Payette Valley, and, at a point about 25 miles from its head, a branch of the same will pass through a low divide and distribute water on the north slope of the Boise Valley. This canal will be practically all in earth and will divert about 650 second-feet. The north side Boise Canal will probably follow the line of the Farmers' Union Canal and its extension and will divert about 800 second-feet.

On the south side of the Boise Valley a dam will be built in Boise River about 8 miles above the city of Boise. This dam will raise the water level 33 feet and divert water into a canal extending to Indian Creek. The channel of Indian Creek will be used for about 9 miles and the water will be again diverted into a canal that will conduct it to the Deer Flat reservoir. This reservoir will be created by the con-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CANAL
LINE
Five Mile Creek
CANAL
NEW YORK CANAL
WM. H. THOMPSON'S CONTRACT
WM. H. THOMPSON'S CONTRACT
DAM
UTAH FIREPROOFING CO.'S CONTRACT
HAZEL RES. D.
HUBBARD RESERVOIR
MAIN SOUTH SIDE CANAL
PAGE AND BENTON'S CONTRACT
R. 1 E.
R. 2 E.
R. 3 E.

struction of two earthen embankments across the outlets of a natural basin and will contain an area of nearly 10,000 acres with a capacity of 186,000 acre-feet. The canal will be 40 feet wide on the bottom, will carry water to a depth of 8 feet, and have a capacity of 1,500 second-feet. This canal is being built with a view to enlarging it at some future time to a bottom width of 70 feet and a capacity of 2,700 feet. It will be used as the main distributing canal on the south side of the Boise Valley and will carry water to more than 200,000 acres. During the nonirrigating season it will be used to conduct the surplus flow of Boise River to the Deer Flat reservior. This reservoir directly commands the irrigation of about 120,000 acres. Each of the reservoir embankments will contain about 1,000,000 cubic yards of earth and gravel. The maximum depth of water at the upper embankment will be 60 feet, and at the lower 30 feet. The works of the south side Boise division are now under construction, to be completed by March 1, 1908.

The works proposed for the Succor Creek division will consist of storage reservoirs on Succor Creek and a gravity canal. It is proposed to install a pumping plant on the banks of Snake River for the irrigation of the lands bordering that stream, the power to be developed at the dam on Payette River.

The water supply for this project will be obtained from Payette and Boise rivers, the natural discharge of both streams to be regulated by reservoirs. An excellent storage site on Payette Lake near the head of Payette River will have a capacity sufficient to regulate the flow of this stream. Storage will be developed at two points on Boise River, one on the North Fork, the other on the Middle Fork. The flood discharge of these streams occurs during May and June and furnishes an adequate supply of water for all grain crops. It is believed that sufficient storage can be developed to provide enough water for the acreage that will require late irrigation.

The Oregon Short Line, Idaho Central, and Boise, Nampa and Owyhee railroads furnish transportation on this project. The Boise Interurban, an electric road running from Boise to Caldwell, is now under construction. The principal towns of the project are Boise, Nampa, Caldwell, Meridian, Parma, and Notus. About 60 per cent of the land of the project is held in private ownership, the remainder being State and Government land.

In the following table are listed the contracts entered into for building work on the Payette-Boise project. This list includes all contracts for excavation, embankment, masonry, and erection of structures, but does not include materials such as cement, steel, timber, etc.

Contracts for building work on Payette-Boise project to June 30, 1906.

No. of contract.	Contractor.	Feature.	Estimated total value.[a]	Payments to June 30, 1906.	Per cent paid.
95	Hubbard & Carlson........	Dam, canal schedule 6....	$256,550.00	$32,021.15	12
97	Conway & Wilhite	Dam, canal schedule 3....	95,400.00	37,496.11	39
103	Page & Brinton............	Main canal schedules 2, 3.	135,900.00	9,057.93	7
104	Utah Fireproofing Co.......	Boise dam..............	158,950.00	7,967.36	5
105	Wm. H. Thompson.........	Main canal schedule 1....	93,325.00	2,438.02	2

[a] For a discussion of advance estimates and final costs see page 51.

BOISE DAM.

Bids for the dam (Pls. XXXVI–XXXVIII) in Boise River were opened February 1, 1906, and the contract for the work was awarded to the Utah Fireproofing Company, which began work early in March, 1906, almost immediately upon the approval by the Secretary of their bid. This contract provides for building a concrete rubble masonry dam with concrete abutments, concrete headworks in canal with cast-iron gates, fishway, logway, and by-pass tunnels around west end of dam. The foundation is a hard compacted gravel. The upper section for the by-pass tunnel has been excavated and a small section of the concrete walls at the upper end has been built. The plant installed by the contractor for doing this work is adequate and efficient, and under proper management the work can be completed by April 1, 1907, the date provided in the contract. Progress under this contract to June 30 has, however, been very slow, only 3 per cent being completed, although the contract provides that 20 per cent of the work shall be done by that date.

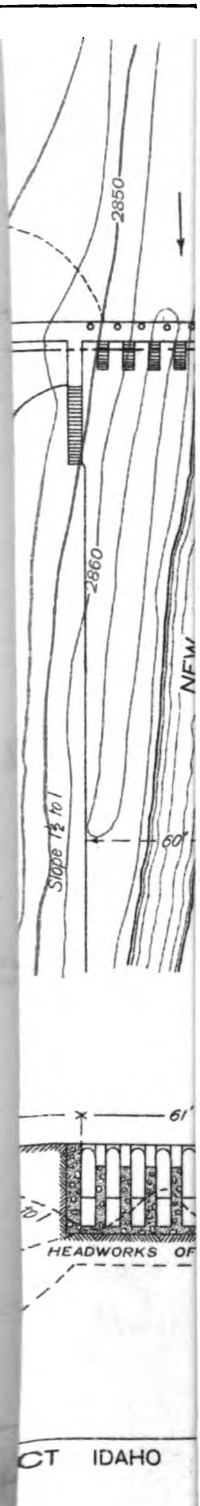
Bids opened February 1, 1906, for dam and diversion works in Boise River, Payette-Boise project.

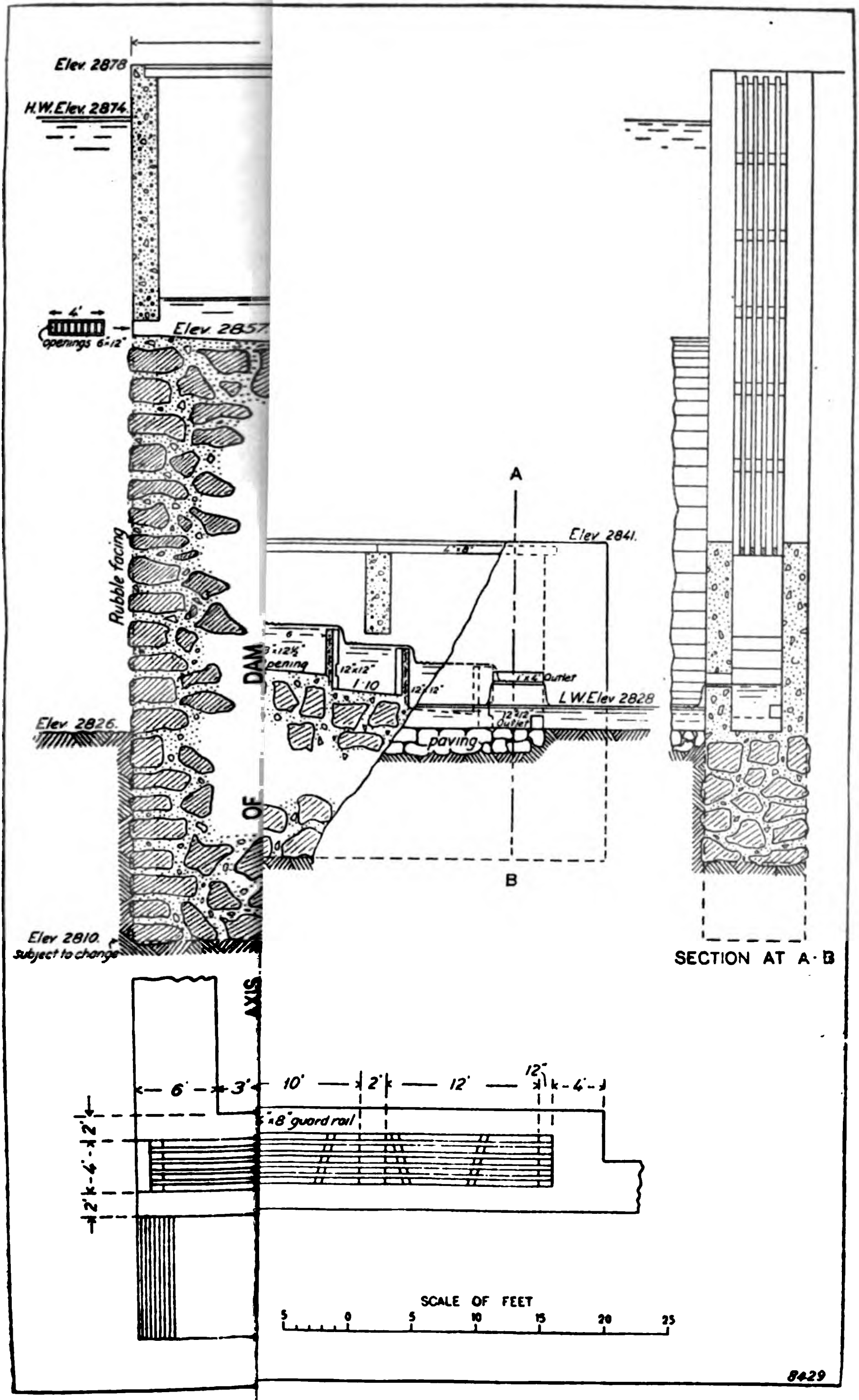
[Schedule 1, specifications No. 68.]

Work or material.	Quantity.	Bates & Rogers Construction Co., Chicago, Ill.		P. McDonnel, Duluth, Minn.	
		Unit price.	Amount.	Unit price.	Amount.
Concrete masonry....cubic yards..	15,000	$5.50	$82,500.00	$4.75	$71,250.00
Concrete....do....	5,000	6.50	32,000.00	6.50	32,500.00
Steel for reenforcing....pounds..	10,000	.08	800.00	.04	400.00
Lumber, common....feet B. M..	325,000	a 35.00	11,375.00	a 30.00	9,750.00
Drift bolts....pounds..	20,000	.07	1,400.00	.04	800.00
Fill in cribwork....cubic yards..	2,500	.75	1,875.00	.50	1,250.00
Excavation, wet:					
Class 1....do....	10,000	2.75	27,500.00	1.60	16,000.00
Class 2....do....	4,000	2.75	11,000.00	1.60	6,400.00
Excavation, dry:					
Class 1....do....	9,000	1.25	11,250.00	1.60	14,400.00
Class 2....do....	3,000	1.25	3,750.00	1.60	4,800.00
Riprap....do....	1,000	2.00	2,000.00	1.50	1,500.00
Total....	....	....	185,950.00	....	159,050.00

Work or material.	Quantity.	Ferris & Kesl, Boise, Idaho.		Utah Fireproofing Co., Salt Lake City, Utah.	
		Unit rate.	Amount.	Unit rate.	Amount.
Concrete masonry....cubic yards..	15,000	$5.75	$86,250.00	$5.00	$75,000.00
Concrete....do....	5,000	7.00	35,000.00	6.00	30,000.00
Steel for reenforcing....pounds..	10,000	.075	750.00	.08	800.00
Lumber, common....feet B. M..	325,000	a30.00	9,750.00	a 30.00	9,750.00
Drift bolts....pounds..	20,000	.075	1,500.00	.07	1,400.00
Fill in cribwork....cubic yards..	2,500	.75	1,875.00	1.00	2,500.00
Excavation, wet:					
Class 1....do....	10,000	3.00	30,000.00	2.00	20,000.00
Class 2....do....	4,000	1.50	6,000.00	2.00	8,000.00
Excavation, dry:					
Class 1....do....	9,000	2.00	18,000 00	.90	8,100.00
Class 2....do....	3,000	1.00	3,000.00	.80	2,400.00
Riprap....do....	1,000	2.50	2,500.00	1.00	1,000.00
Total....	....	....	194,625.00	....	158,950.00

[a] M feet B M.


2850
2860
NEW
Slope 1½ to 1
60'
61'
to 1
HEADWORKS OF
CT IDAHO


Elev. 2878
H.W.Elev. 2874
4'
openings 6"×12"
Elev. 2857
Rubble facing
Elev. 2826
Elev. 2810
subject to change
DAM
OF
AXIS
A
B
Elev. 2841
4"×8"
6
3"×12½" opening
12"×12"
1:10
12"×12"
1"×4" Outlet
L.W.Elev. 2828
12"×12" Outlet
paving
SECTION AT A·B
6'
3'
10'
2'
12'
12"
4'
4"×8" guard rail
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2'
SCALE OF FEET
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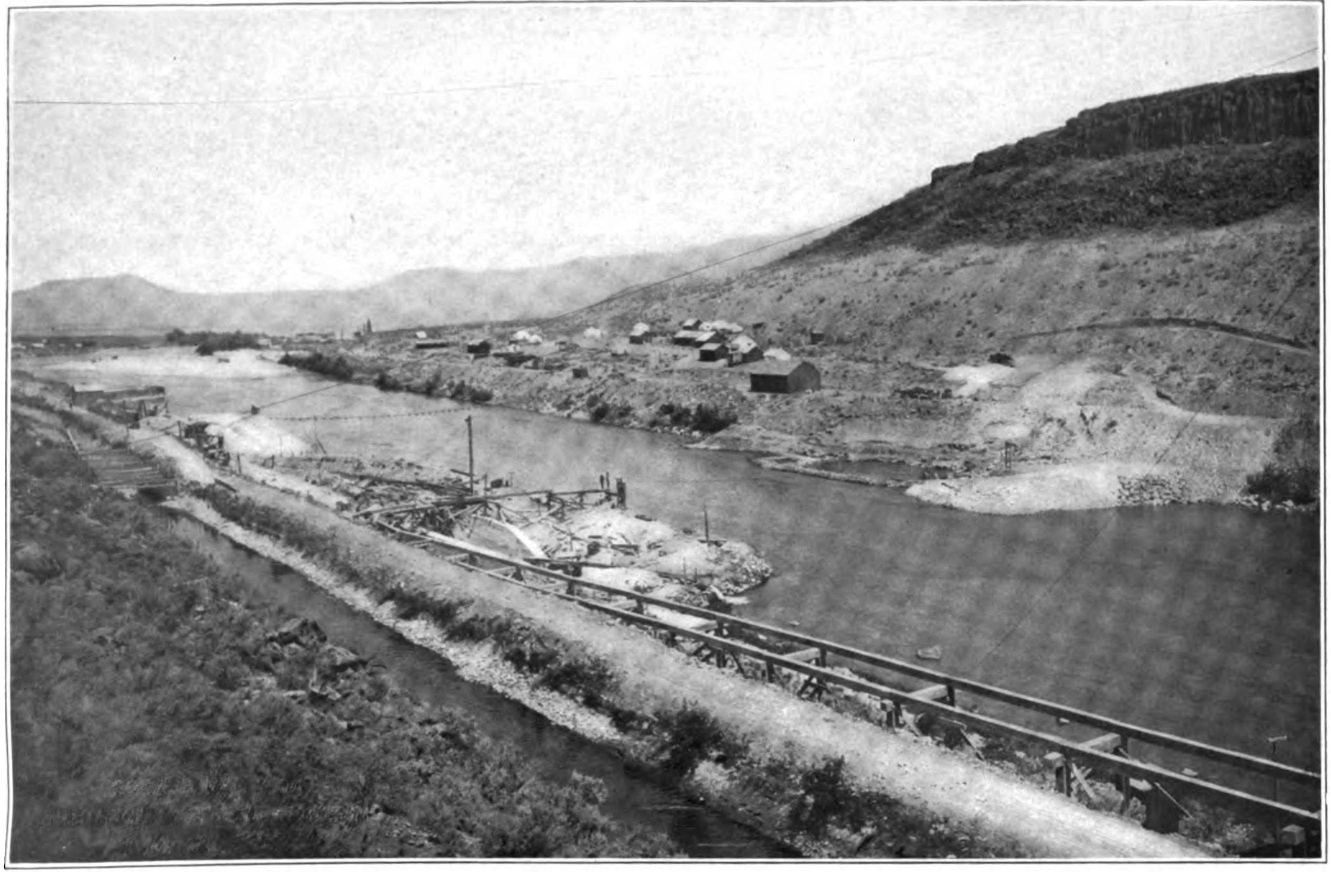


THE BOISE RIVER DAM, PAYETTE-BOISE PROJECT, IDAHO, UNDER CONSTRUCTION, LOOKING DOWNSTREAM, AUGUST 9, 1906.

GATES.

Bids for the controlling gates for the dam in Boise River were opened February 1, 1906, and the contract was awarded to the United Iron Works, of Oakland, Cal. An abstract of the bids received is given in the following table:

Bids opened February 1, 1906, for gates and lifting devices, Payette-Boise project.

[Schedule No. 7, specifications No. 68.]

Work or material.	Quantity.	Page & Brinton, Salt Lake City, Utah.		Monad Engineering Co., New York, N. Y.	
		Unit price.	Amount.	Unit price.	Amount.
Cast-iron gates and guides:	*Pounds.*				
14 gates, 5 by 9 feet	70,000	$0.15	$10,500.00	$0.08	$5,600.00
8 gates and guides, 5 by 6 feet	32,000	.15	4,800.00	.12	3,840.00
2 standard gates with lifting stems and ball bearing pedestals for raising 80,000 pounds		500.00	1,000.00	907.00 957.00	1,814.00 1,914.00
Lifting devices:					
8 standard ball-bearing lifting devices for raising 20,000 pounds		400.00	3,200.00	244.00 273.00	1,952.00 2,184.00
6 standard ball-bearing lifting devices for raising 15,000 pounds		400.00	2,400.00	232.00 262.00	1,392.00 1,572.00
8 standard ball-bearing screw lifting devices for lifting 30,000 pounds		500.00	4,000.00	281.00 311.00	2,248.00 2,488.00
Total			25,900.00		
One speed					16,846.00
Two speed					17,598.00

Work or material.	Quantity.	New Jersey Foundry and Machine Co., New York, N. Y.		United Iron Works, Oakland, Cal.	
		Unit price.	Amount.	Unit price.	Amount.
Cast-iron gates and guides:	*Pounds.*				
14 gates, 5 by 9 feet	70,000	$0.08¼	$5,775.00	$0.06¾	$4,725.00
8 gates and guides, 5 by 6 feet	32,000	.11	3,520.00	.06¾	2,160.00
2 standard gates with lifting stems and ball-bearing pedestals for raising 80,000 pounds		1,000.00 1,070.00	2,000.00 2,140.00	1,350.00	2,700.00
Lifting devices:					
8 standard ball-bearing lifting devices for raising 20,000 pounds		280.00 310.00	2,240.00 2,480.00	240.00	1,920.00
6 standard ball-bearing lifting devices for raising 15,000 pounds		270.00 290.00	1,620.00 1,740.00	190.00	1,140.00
8 standard ball-bearing screw lifting devices for lifting 30,000 pounds		320.00 360.00	2,560.00 2,880.00	300.00	2,400.00
Total					15,045.00
One speed			17,715.00		
Two speed			18,535.00		

Bids opened February 1, 1906, for gates and lifting devices, Payette-Boise project—Continued.

Work or material.	Quantity.	Coldwell Wilcox Co., Newburgh, N. Y.		Chapman Valve Manufacturing Co., Indian Orchard, Mass.	
		Unit price.	Amount.	Unit price.	Amount.
Cast-iron gates and guides:	*Pounds.*				
14 gates, 5 by 9 feet	70,000	$0.13	$9,100.00	$0.07	$4,900.00
8 gates and guides, 5 by 6 feet	32,000	.13	4,160.00	.07	2,240.00
2 standard gates with lifting stems and ball-bearing pedestals for raising 80,000 pounds		1,757.50	3,515.00	658.00	1,316.00
Lifting devices:					
8 standard ball-bearing lifting devices for raising 20,000 pounds		184.50	1,476.00	201.00	1,608.00
6 standard ball-bearing lifting devices for raising 15,000 pounds		174.50	1,047.00	192.00	1,152.00
8 standard ball-bearing screw lifting devices for lifting 30,000 pounds		215.50	1,724.00	214.00	1,712.00
Total			21,022.50		12,928.00

Work or material.	Quantity.	Camden Iron Works, Camden, N. J.		I. P. Morris Co., Philadelphia, Pa.	
		Unit price.	Amount.	Unit price.	Amount.
Cast-iron gates and guides:	*Pounds.*				
14 gates, 5 by 9 feet	70,000	$0.115	$8,050.00	$0.15	$10,500.00
8 gates and guides, 5 by 6 feet	32,000	.12	3,840.00	.155	4,960.00
2 standard gates with lifting stems and ball-bearing pedestals for raising 80,000 pounds		1,375.00	2,750.00	2,180.00	4,360.00
Lifting devices:					
8 standard ball-bearing lifting devices for raising 20,000 pounds		385.00 430.00	3,080.00 3,440.00	500.00	4,000.00
6 standard ball-bearing lifting devices for raising 15,000 pounds		320.00 360.00	1,920.00 2,160.00	500.00	3,000.00
8 standard ball-bearing screw lifting devices for lifting 30,000 pounds		330.00 380.00	2,640.00 3,040.00	650.00	5,200.00
Total					32,020.00
One speed			22,280.00		
Two speed			23,280.00		

MAIN CANAL.

The main canal from Boise River to the Deer Flat reservoir will have a width of 40 feet on the bottom, inside slopes of 1½ to 1, and a capacity of 1,500 second-feet when the water is 8 feet deep. It is planned with a view to ultimately enlarging it to a bottom width of 70 feet, which will give a capacity of 2,700 second-feet. It will be used during the winter and early spring months to fill the Deer Flat reservoir and later on to distribute water to about 160,000 acres of land on the south side of Boise River. Bids for excavation and structures on the main canal were opened February 1, 1906. The contract for the structures (schedule 4, specifications No. 68) was awarded to Page & Brinton, of Salt Lake City, Utah, and that for excavation between Indian Creek and Deer Flat reservoir (schedule 3) was awarded to Conway & Wilhite. As the bids for the excavation of the canal between Boise River and Indian Creek (schedule 2) were greater than the engineers' estimates they were all rejected and the work was readvertised. The second set of bids for the excavation of the main canal from Boise River to Indian Creek (specifications No. 79) were opened on April 16 and contracts were awarded as follows: Schedule 1 to William H. Thompson: schedules 2 and 3 to Page & Brinton.

Bids opened February 1, 1906, for structures on canal from Boise River to Deer Flat reservoir, Payette-Boise project.

[Schedule 4, specifications No. 68.]

Work.	Quantity.	Ferris & Kesl, Boise, Idaho.		Page & Brinton, Salt Lake City, Utah.	
		Unit price.	Amount.	Unit price.	Amount.
Bridges:					
Concrete........................cubic yards..	500	$10.00	$5,000.00	$8.00	$4,000.00
Iron bolts and tie rods............pounds..	40,000	.10	4,000.00	.08	3,200.00
Common lumber.................feet B. M..	125,000	a 35.00	4,375.00	a 60.00	7,500.00
Turnouts:					
Concrete........................cubic yards..	2,800	12.50	35,000.00	7.00	19,600.00
Steel.............................pounds..	4,000	.075	300.00	.09	360.00
Culverts and drops:					
Concrete........................cubic yards..	1,100	12.50	13,750.00	8.00	8,800.00
Steel.............................pounds..	6,500	.075	487.50	.07	455.00
Diverting works from Indian Creek:					
Concrete........................cubic yards..	600	12.50	7,500.00	8.00	4,800.00
Steel.............................pounds..	2.000	.075	150.00	.07	140.00
Total................................	....	....	70,562.50	....	48,855.00

a M feet BM.

Bids opened February 1, 1906, for main canal from Boise River to Indian Creek, Payette-Boise project.

[Schedule 2, specifications No. 68.]

Work.	Quantity.	Hubbard & Carlson, Boise, Idaho.	
		Price per cubic yard.	Amount.
Excavation:	*Cu. yds.*		
Class 1................................	830,000	$0.17	$141,100.00
Class 2................................	56,500	.40	22,600.00
Class 3................................	56,500	.50	28,250.00
Class 4................................	32,000	.70	22,400.00
Class 5................................	10,000	1.40	14,000.00
Riprap................................	3,500	1.25	4,375.00
Total................................	....	....	232,725.00

Bids opened February 1, 1906, for main canal from Indian Creek to Deer Flat reservoir, Payette-Boise project.

[Schedule 3, specifications No. 68.]

Work.	Quantity.	Hubbard & Carlson, Boise, Idaho.		Conway & Wilhite, Star, Idaho.		Page & Brinton, Salt Lake City, Utah.	
		Price per cubic yard.	Amount.	Price per cubic yard.	Amount.	Price per cubic yard.	Amount.
Excavation:	*Cu. yds.*						
Class 1....................	320,000	$0.15	$48,000.00	$0.14	$44,800.00	$0.17	$54,400.00
Class 2....................	60,000	.35	21,000.00	.35	21,000.00	.33	19,800.00
Class 3....................	16,000	.48	7,680.00	.50	8,000.00	.60	9,600.00
Class 4....................	3,800	.70	2,660.00	.75	2,850.00	.70	2,660.00
Class 5....................	15,000	1.40	21,000.00	1.25	18,750.00	1.00	15,000.00
Total....................	....	....	100,340.00	....	95,400.00	....	101,460.00

Bids opened April 16 1906, for main canal from Boise River to Indian Creek, Payette Boise project.

[Specifications No. 79.]

SCHEDULE 1.

Work.	Quantity.	William H. Thompson, Boise, Idaho.		Smith & Youngkin, Boise, Idaho.		Page & Brinton, Salt Lake City, Utah.	
		Price per cubic yard.	Amount.	Price per cubic yard.	Amount.	Price per cubic yard.	Amount.
Station 2+00 "A" to station 38+00 "A."							
Excavation:	*Cubic yds.*						
Class 1	74,000	$0.18	$13,320.00	$0.21	$15,540.00	$0.40	$29,600.00
Class 2	5,000	.45	2,250.00	.50	2,500.00	1.00	5,000.00
Class 3	5,000	.55	2,750.00	.60	3,000.00	1.25	6,250.00
Class 4	1,000	1.25	1,250.00	1.15	1,150.00	2.00	2,000.00
Riprap	3,500	1.25	4,375.00	1.25	4,375.00	2.00	7,000.00
Station 0+00 "B" to station 316+80 "B."							
Excavation:							
Class 1	281,000	.18	50,580.00	.21	59,010.00	.21	59,010.00
Class 2	28,000	.45	12,600.00	.50	14,000.00	.50	14,000.00
Class 3	5,000	.55	2,750.00	.60	3,000.00	.70	3,500.00
Class 4	3,000	1.15	3,450.00	1.15	3,450 00	1.50	4,500.00
Total			93,325.00		106,025.00		130,860.00

SCHEDULE 2.

Station 316+80 "B" to station 686+40 "B."							
Excavation:							
Class 1	245,000	$0.155	$38,975.00	$0.21	$51,450.00	$0.15	$36,750.00
Class 2	40,000	.45	18,000.00	.50	20,000.00	.50	20,000.00
Class 3	11,000	.55	6,050.00	.60	6,600.00	.80	8,800.00
Class 4	3,000	1.15	3,450.00	1.15	3,450.00	1.40	4,200.00
Total			66,475.00		81,500.00		69,750.00

SCHEDULE 3.

Station 686+40 "B" to station 1004 "B."							
Excavation:							
Class 1	230,000	$0.17	$39,100.00			$0.165	$37,950.00
Class 2	40,000	.45	18,000.00			.40	16,000.00
Class 3	11,000	.55	6,050.00			.70	7,700.00
Class 4	3,000	1.15	3,450.00			1.50	4,500.00
Total			66,600.00				66,150.00

Work on main canal from Boise River to Indian Creek (schedule 1, specifications No. 79) under William H. Thompson's contract, dated May 12, 1906, was begun during June, 3 per cent having been completed by June 30. This canal follows closely the line of the New York canal in which water is conducted for irrigation. The work is to be completed March 1, 1908.

Work on schedules 2 and 3 (specifications No. 79), main canal, from Boise River to Indian Creek, Page & Brinton, contractors, was begun during the latter part of May, and 7 per cent completed by June 30. The date set for completion of this canal is March 1, 1908, and the contractors will have no difficulty in completing the work by that time.

Work on the main canal, from Indian Creek to Deer Flat, by Conway & Wilhite (schedule 3, specifications No. 68), was well advanced at the close of the fiscal year, 49 per cent being completed. The work under this contract has been very vigorously pushed from its inception and no difficulty will be experienced in completing it on time.

UPPER DEER FLAT EMBANKMENT.

Bids for the work on the Upper Deer Flat embankment (Pls XXXIX and XL) were opened February 1, 1906, but as all the bids were in excess of the engineers' estimates the work will be done directly by the Government.

Bids opened February 1, 1906, on Upper Deer Flat embankment and diverting works, Payette-Boise project.

[Schedule 5, Specifications No. 68.]

Work.	Quantity.	P. McDonnell, Duluth, Minn.		Hubbard & Carlson, Boise, Idaho.		Ferris & Kesl, Boise, Idaho.	
		Unit price.	Amount.	Unit price	Amount.	Unit price.	Amount.
Embankment, earth and gravel fill..............cubic yards..	1,000,000	$0.36	$360,000.00	$0.37	$370,000.00	$0.375	$375,000.00
Excavation in foundation:							
Class 1................do....	20,000	.18	3,600.00	15	3,000.00	.20	4,000.00
Class 2................do....	5,000	.50	2,500 00	.30	1,500.00	.40	2,000.00
Class 3................do....	5,000	.50	2,500.00	.35	1,750 00	.50	2,500.00
Diverting works:							
Concrete.............do....	2,500	4.50	11,250.00	5.00	12,500.00	10.00	25,000.00
Steel for reinforcing ....lbs..	20,000	.04	800.00	.04	800.00	.075	1,500.00
Steel in bridge and canopy..............lbs..	10,000	.15	1,500.00	.04	400.00	.125	1,250.00
Total..................	....	....	382,150.00	....	389,950.00	....	411,250.00

On March 15 bids for furnishing equipment to be used by the Reclamation Service in the construction of the Upper Deer Flat embankment were opened in Chicago, Ill. Following is a list of equipment purchased for this work with names of successful bidders:

Equipment purchased for construction of Upper Deer Flat embankment.

Article.	No.	Purchased from.	Price.	Freight.	Total.
Steel road machines..........	2	Austin Manufacturing Co., Chicago, Ill.	$390	$212	$602
Dump cars....................	60	Kilbourn-Jacobs Manufacturing Co.	10,020	3,104	13,124
Locomotives..................	4	Vulcan Iron Works, Wilkes-Barre, Pa.	12,000	1,434	13,434
Steam shovels, 2½ cubic yards capacity.	2	Atlantic Equipment Co., New York, N. Y.	17,500	1,723	19,223
Sprinkling carts.............	5	Austin Western Co., Chicago, Ill...	950	602	1,652
Steel rails and equipment....	1,070	Illinois Steel Co., Chicago, Ill.......	6,090	3,033	9,123
Ties.........................	9,000	Shaw & Kivett, Boise, Idaho.......	4,300	....	4,300
Lumber.......................	....	.....do............................	1,204	....	1,204

Up to June 30 only preparatory work had been done, it having been impossible to arrange for the delivery of steam shovels earlier than August. The following equipment has been received: Sixty 4-yard dump cars, four 10 by 16 narrow-gauged locomotives, 5 sprinkling carts of 600 gallons capacity each, 2 road machines, a limited amount of small tools, such as shovels, picks, bars, blocks, and tackles, and all necessary vitrified pipe to be used for draining the lower side of embankment. The material and machinery remaining to be delivered consist of 190 tons of steel rails with accessories, two 70-ton steam shovels, steam pump, steam boiler, and pipe for water supply. Clearing and burning brush and otherwise preparing the site of dam is well under way, as well as the erection of a headquarters building, cook and mess house, and quarters for the men that will be employed.

LOWER DEER FLAT EMBANKMENT.

Bids on the Lower Deer Flat embankment were opened February 1, 1906, and the contract was awarded to Hubbard & Carlson, of Boise, Idaho.

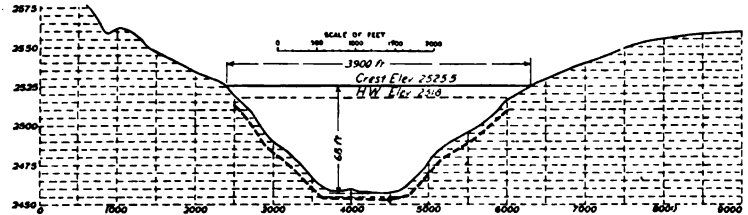
By June 30 this work was well under way, 16 per cent being completed. The contract provides for the completion of the embankment by October 1, 1907. This embankment is composed of earth, with a section of gravel on the lower side and a 3-foot covering of coarse gravel on the upper face, the upper slope being 3 to 1 and the lower 2 to 1. It is 7,300 feet long on top, with a maximum height of 43 feet, and will contain about 950,000 cubic yards.

Bids opened February 1, 1906, on Lower Deer Flat embankment and diverting works, Payette-Boise project.

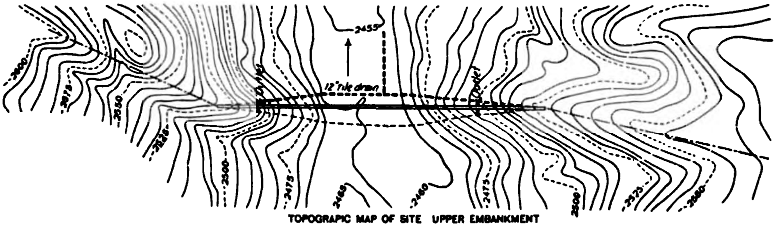
[Schedule 6, specifications No. 68.]

Work.	Quantity.	P. McDonnel, Duluth, Minn.		Hubbard & Carlson, Boise, Idaho.	
		Unit price.	Amount.	Unit price.	Amount.
Embankment:					
(a) Earth and gravel body with gravel face and back .... cubic yards..	950,000	$0.38	$361,000.00	....	....
(b) Earth body with gravel face and back .... cubic yards..	850,000	.29	246,500.00	$0.24	$204,000.00
Face and back .... do....	100,000	.39	39,000.00	.35	35,000.00
Excavation in foundation:					
Class 1 .... do....	40,000	.18	7,200.00	.15	6,000.00
Class 2 .... do....	5,000	.50	2,500.00	.30	1,500.00
Class 3 .... do....	5,000	.50	2,500.00	.35	1,750.00
Diverting works:					
Concrete .... do....	1,500	4.75	7,125.00	5.00	7,500.00
Steel for reinforcing .... pounds..	15,000	.04	600.00	.04	600.00
Steel in bridge and canopy .... do....	5,000	.15	750.00	.04	200.00
Total	....	....	381,675.00	....	256,550.00

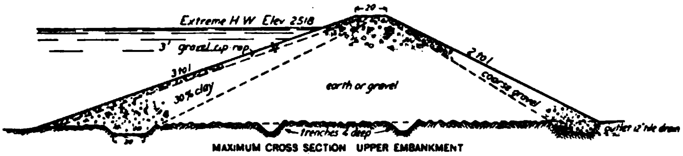
Work.	Quantity.	Ferris & Kesl, Boise, Idaho.		Page & Brinton, Salt Lake City, Utah.		Clemont & Strange, Salt Lake City, Utah.	
		Unit price.	Amount.	Unit price.	Amount.	Unit price.	Amount.
Embankment:							
(a) Earth and gravel body with gravel face and back .... cubic yards..	950,000	$0.45	$427,500.00	$0.52	$494,000.00	....	....
(b) Earth body with gravel face and back .... cubic yards..	850,000	.31	263,500.00	.23	195,500.00	$0.32	$272,000.00
Face and back ... cubic yards..	100,000	.40	40,000.00	1.00	100,000.00	.42	42,000.00
Excavation in foundation:							
Class 1 .... do....	40,000	.20	8,000.00	.17	6,900.00	.26	10,400.00
Class 2 .... do....	5,000	.35	1,750.00	.25	1,250.00	.38	1,900.00
Class 3 .... do....	5,000	.50	2,500.00	.35	1,750.00	.50	2,500.00
Diverting works:							
Concrete .... do....	1,500	10.00	15,000.00	10.00	15,000.00	7.50	11,250.00
Steel for reinforcing .. pounds..	15,000	.075	1,125.00	.10	1,500.00	.05	750.00
Steel in bridge and canopy .... pounds..	5,000	1.25	625.00	.10	500.00	.08	400.00
Total	....	....	496,500.00	....	520,800.00	....	341,200.00



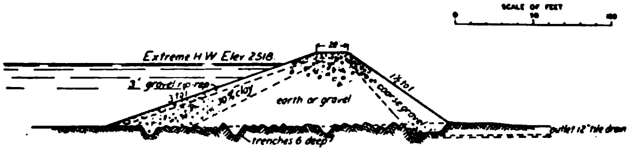
PROFILE ON AXIS OF EMBANKMENT



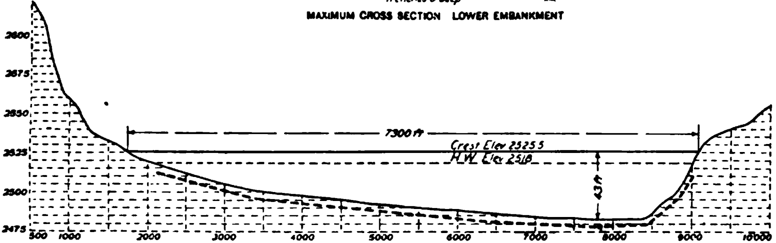
TOPOGRAPIC MAP OF SITE UPPER EMBANKMENT



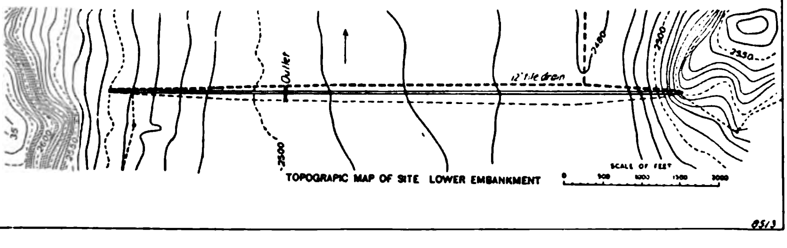
MAXIMUM CROSS SECTION UPPER EMBANKMENT



MAXIMUM CROSS SECTION LOWER EMBANKMENT



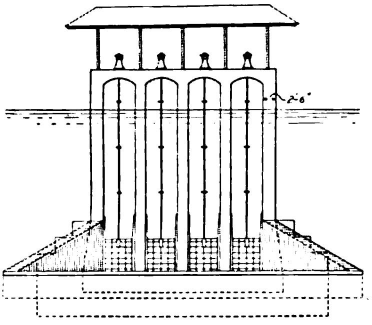
PROFILE ON AXIS OF EMBANKMENT



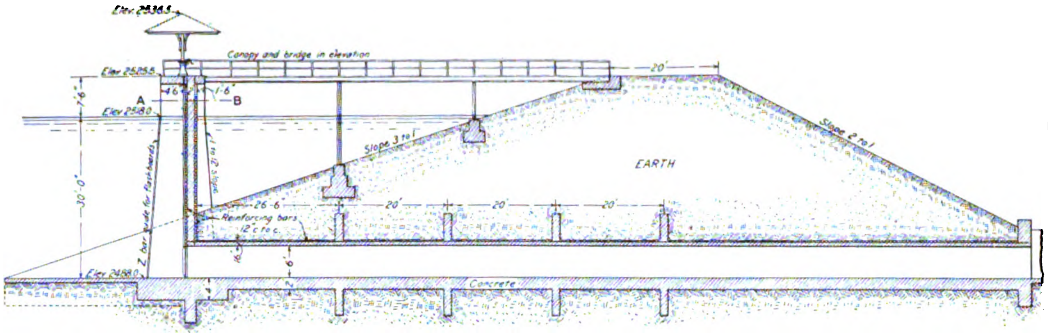
TOPOGRAPIC MAP OF SITE LOWER EMBANKMENT

6513

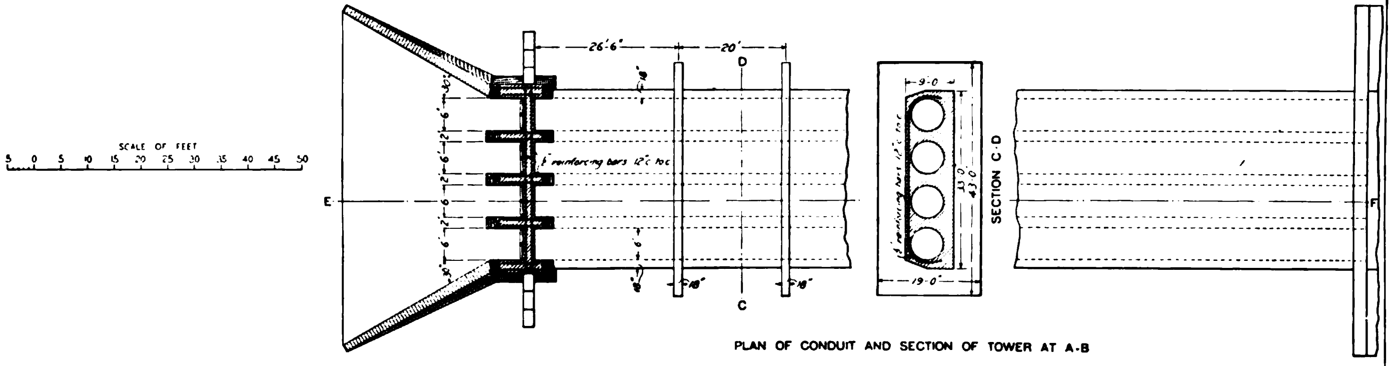
UPPER AND LOWER EMBANKMENTS, DEER FLAT RESERVOIR, PAYETTE-BOISE PROJECT, IDAHO.



FRONT ELEVATION



SECTION ON LINE OF CONDUIT E-F



PLAN OF CONDUIT AND SECTION OF TOWER AT A-B

EAST END OUTLET FROM UPPER EMBANKMENT, DEER FLAT RESERVOIR, PAYETTE-BOISE PROJECT, IDAHO.

CEMENT.

Bids were opened at Boise on March 9, 1906, for furnishing 14,000 barrels of Portland cement to be used on the Payette-Boise project. Only one bid was received, that of the Portland Cement Company, of Portland, Colo , which offered to furnish cement f. o. b. at any point within a radius of 25 miles of Nampa, Idaho, at $3.90 per barrel, or f. o. b. at its mills at $1.75 per barrel. This bid was rejected by the Secretary of the Interior and authority was given for an emergency purchase of 2,000 barrels, and the following eight firms were invited, on April 2, 1906, to make quotations for the delivery of 1,000 barrels within five days and of 1,000 barrels on April 15; J. M. Moore, Portland, Oreg.; Pacific Portland Cement Company, San Francisco, Cal.; Portland Cement Company of Utah, Salt Lake City, Utah; Balfour, Guthrie & Co., Portland, Oreg.; Kansas Portland Cement Company, Iola, Kans.; Iola Portland Cement Company, Iola, Kans.; J. D. Spreckles & Co., San Francisco, Cal.; Illinois Steel Company, Chicago, Ill. Only one firm, the Illinois Steel Company, of Chicago, Ill., would quote prices, and an order was placed with this company for 2,000 barrels, at $1.55 f. o. b. at mills, Chicago.

On March 29, 1906, invitations were addressed to 22 cement manufacturers to submit bids for the delivery of 14,000 barrels of cement, more or less, for this project. Only one bid, that of the Illinois Steel Company, of Chicago, Ill., was received, the price f. o. b. cars at their mills at Chicago being $1.60 per barrel. This bid was accepted.

IRRIGABLE LANDS.

The area of the irrigable lands situated below the level of the proposed canal system is 211,650 acres, not counting about 50,000 acres lying south of the Oregon Short Line Railway that will be reclaimed by future extension of the New York canal. The distribution of these lands is shown in the following schedule.

Area and distribution of land susceptible of irrigation and lands under contract for water rights with the Payette-Boise Water Users' Association.

ABOVE RESERVOIR.

Canal or district.	Pledged to project.				Not pledged to project.		
	Public.	State.	Private.	Total.	Private.	Per cent of whole.	Total.
	Acres.	*Acres.*	*Acres.*	*Acres.*	*Acres.*		*Acres.*
New York Canal to Indian Creek	6,635	1,210	10,570	18,415	15,495	43	33,190
Nampa-Meridian irrigation district	790	3,390	48,135	52,313	8,735	14	61,050
Pioneer irrigation district			6,790	6,790	2,090	22	8,880
Total	7,425	4,600	65,495	77,520	26,320	25	103,840
BELOW RESERVOIR.							
Nampa-Meridian irrigation district	[a] 320	([b])	[c] 5,220	[d] 5,540	[e] 4,870	47	10,410
Pioneer irrigation district		660	19,270	19,930	5,110	15	25,040
West of Deer Flat	24,610	8,140	6,980	39,730	1,630	4	41,360
Riverside canal	5,100	1,550	4,290	10,940	1,060	9	12,000
Seebre canal	1,600	1,500	7,040	10,140	8,860	46	19,00
Total below reservoir	31,630	11,850	42,800	86,280	21,530	20	107,810
Total above reservoir	7,425	4,600	65,495	77,520	26,320	25	103,840
Grand total	39,055	16,450	118,295	163,800	47,850	22	211,650

[a] 120 acres in reservoir deducted.

[b] 160 acres in reservoir deducted.

[c] 660 acres in reservoir deducted.

[d] 2,560 acres in reservoir deducted.

[e] 2,720 acres in reservoir deducted.

The foregoing table shows that of the 103,840 acres of irrigable lands situated above the reservoir 65,495 acres in private ownership are under contract. There are also 7,425 acres of public land in this area and 4,600 acres belonging to the State, making 77,520 acres pledged to project, or 75 per cent of the total area. No special effort was made by the association to have contracts entered into for any of these lands, since they would not be directly benefited by the Deer Flat reservoir. There are tributary to the reservoir 107,800 acres, of which 42,800 acres held in private ownership are under contract, 31,630 acres are public land, and 11,850 acres belong to the State, making 86,280 acres of such land pledged to the project, or 80 per cent of the whole. Of the total area of 211,650 acres tributary to the works now being built 163,800 acres, or 78 per cent, are pledged. Of this amount 118,295 acres are private land, 16,450 acres belong to the State of Idaho, and 39,055 acres have been entered under the reclamation act. Inasmuch as this is perhaps a larger area than can be furnished with water from the present works it is not likely that an effort will be made to secure any more contracts.

It is estimated that the Deer Flat reservoir will furnish water for the irrigation of about 120,000 acres, or a greater area than is situated below its level. In addition, however, to the lands referred to in the table there are below the reservoir 15,000 to 20,000 acres on the first bottom of Boise River below the mouth of Tenmile Creek. These lands will have a water right that will be prior to that of the bench lands of the Boise Valley. It will be entirely feasible to divert water from the reservoir for the use of these lands during the latter part of the irrigation season and to transfer these older rights to lands situated under the high-line canals of this division, as the New York and Ridenbaugh. In this way the entire supply stored in Deer Flat reservoir can be utilized to the best possible advantage, as most of the owners of land on the south side of Boise River have an equity in existing irrigation facilities, some through the ownership of stock, others by reason of their holdings within the boundaries of irrigation districts. In every case the existing works can be utilized as parts of a more comprehensive system, so it became necessary to agree as to the credit which would be allowed such water users for existing works on the purchase price of shares in the association.

With a view to enabling every landowner to lend his assistance to the project and enter into the necessary contracts without delay, and at the same time to insure him full consideration and protection in his existing rights, it was agreed that stock subscriptions should not be regarded as delivered or as having any binding force or effect until the company of which he was a member or the district in which he was located should have entered into an agreement with the water users' association or with the United States.

In pursuance of this agreement the water users' association and representatives of the various irrigation districts and canal companies involved mutually agreed that a flat rate of $14 per acre for existing works would be fair, which would leave approximately $11 per acre for the cost of a supplementary water right, which would really be the cost of storage, the districts and companies involved already having their distributing system and water rights for early irrigation. The distribution of this credit was reached in two ways; first, by a direct estimate of the cost or value of the existing canals and distributing systems which have been constructed by the land owners, and, second, by an estimate of the cost of the storage system that would be built by the United States in connection with this project.

Contracts have been entered into between the Payette-Boise Water Users' Association and the United States, and between the Water Users' Association and the Riverside Irrigation District Limited, and the Pioneer Irrigation District. The terms of a similar contract with the Nampa-Meridian Irrigation District have been agreed to, but its execution has been deferred, pending the preparation by the district of a list of the irrigated lands, which list will serve as a basis for future levies to be made by the district. It is expected that this list will soon be prepared.

RIGHT OF WAY.

The most feasible location for the main canal for this system follows the line of the New York canal and its extensions, and it became necessary to make arrangements with the companies owning this property for right of way. Negotiations leading to the conclusion of these arrangements were conducted by the Reclamation Service, and contracts bearing date of March 3, 1906, were entered into with the New York Canal Company and the Idaho-Iowa Lateral and Reservoir Company. These contracts give the United States the right to enlarge and extend any portion of these properties which may be needed in building a canal system. The United States, in consideration of this right, agrees to deliver to the stockholders of these companies the water to which they are already entitled by virtue of their respective equities in these properties, and to deliver to others such water as they are now receiving under the provisions of certain contracts and water deeds which are held with said companies, the amount of water and priority of rights to be such as may subsequently be determined by the courts. These provisions are simply in effect the recognition by the United States of the vested water rights of the irrigators under these systems.

The arrangements made with these companies are of great advantage to the United States, as a great saving will be effected. The irrigators under these systems will in turn be greatly benefited, chiefly on account of the lower maintenance charges. The present status of their water rights will, of course, remain undisturbed.

Negotiations have been successfully conducted for the purchase of lands needed for the Deer Flat reservoir. These negotiations have been carried on on behalf of the United States by the water users' association. A uniform price of $15 per acre for unimproved desert land was agreed to by the association as being a fair valuation. This reservoir covers 9,646.1 acres, divided as follows: Vacant Government land, 159 acres; land granted to the State of Idaho, 419.7 acres; unimproved land for which patent has been issued, 6,338.2 acres; improved land for which patent has been issued, 591.8 acres; land for which final proof has been offered and certificates issued, 480 acres; land held under the homestead law, 1,417.4 acres, and land that formerly belonged to the State, but which has been sold and on which a payment of one-tenth the purchase price, with interest, has been made, 240 acres.

Of the lands held in private ownership, contracts for the purchase of 2,780.59 acres have been entered into. The following table shows the status of these contracts at the close of the present fiscal year. The other contracts will be closed from time to time as titles are examined and approved.

Contracted lands needed for right of way for the Deer Flat reservoir, for which payment has not been made.

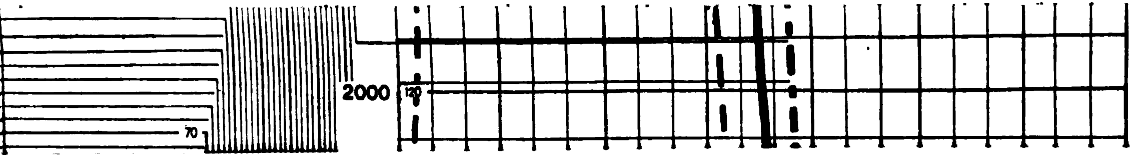
Name.	Date of agreement.	Length of option.	Date agreement expires.	Number of acres.	Price per acre.	Total price.
	1905.		1906.			
John Lynch	Oct. 18	6 months	Apr. 18	80	$60.00	$4,800.00
D. E. Gott	do	do	do	70	93.71	6,560.00
W. H. Richards	do	do	do	38	118.42	4,500.00
S. C. Sciam	do	do	do	27	100.00	2,700.00
Thos. Smith	do	do	do	81.7	70.23	5,738.00
F. W. Richards	do	do	do	80	106.25	8,500.00
Lars F. Sundman	Apr. 27	1 year	Apr. 27	80	15.00	1,200.00
C. H. Harris	Nov. 21	6 months	May 21	99	103.23	10,220.00
H. A. Partridge	May 25	1 year	May 25	320	15.00	4,000.00
L. N. B. Carpenter	June 17	do	June 17	20	15.00	300.00
Wm. H. Conway	Dec. 20	6 months	June 20	160	15.00	2,400.00
Ole E. Larson	July 18	1 year	July 18	22	15.00	330.00
D. W. Rathfon	Aug. 11	do	Aug. 11	122	15.00	1,830.00
W. L. Hasbrouck	do	do	do	160	15.00	2,400.00
W. H. Jessee	do	do	do	17	15.00	255.00
T. D. Poston	do	do	do	160	15.00	2,400.00
Jean McMahon	do	do	do	137	15.00	2,055.00
Mary E. Ridenbaugh	Sept. 8	do	Sept. 8	80	15.00	1,200.00
Hattie A. Richards	Sept. 15	do	Sept. 15	10	100.00	1,000.00
H. B. Aven	Apr. 12	do	Apr. 12	160	62.50	10,000.00
Wm. A. Pleasants	Nov. 14	6 months	May 14	97	15.00	1,455.00
L. C. Polley	Jan. 10	do	July 10	118	15.00	1,770.00
H. L. Brandt	Aug. 11	1 year	Aug. 11	160	15.00	2,400.00
Do	do	do	do	80	15.00	1,200.00
Do	do	do	do	160	15.00	2,400.00
L. H. Crawford	do	do	do	81.89	15.00	1,228.35
	1906.					
Wm. J. Duval	Apr. 30	3 months	July 31	160	75.00	12,000.00
Total				2,780.59		94,841.35

Under date of February 1, 1906, the Secretary of the Interior issued instructions to the register and receiver of the United States land office at Boise to suspend all proofs offered on entries situated within the boundaries of this reservoir and authorized the Reclamation Service to negotiate for the purchase of the improvements on the same, the entries then to be canceled. This order was subsequently explained, and in a measure modified, to the extent of admitting that claims, the proof of which had already been offered at the time of issuing said order, should have the same status as patented lands. This will necessitate the purchase of these claims, for which $15 per acre will have to be allowed. Some of the landowners have protested against the appraisal made by the water users' association, and it will doubtless be necessary in some of these cases to resort to condemnation proceedings.

LITIGATION.

On the 29th day of March, 1906, Mrs. R. E. Green filed a petition in the district court of Idaho, asking that the contractors (Conway & Wilhite) be enjoined from entering upon her land for the purpose

78		1-82	[illegible]	.9	1027.5
77	Oct.	29-80	Franklin Ditch Co	27.6	1026.6
76	"	20-80	Joseph Goble	.9	999.0
75	June	1-80	Isham Joplin	2.4	998.1
74	"	1-80	R H Stockton	1.8	995.7
73	"	1-79	D Mumford	4.0	993.9
72	"	1-79	New Dry Creek Ditch Co	31.3	989.9
71	"	1-78	R. H. Stockton.	4.4	958.6
70	"	1-78	Charles Allen	8.8	954.2
69	"	1-78	John Mammon	3.4	945.4



of constructing a canal under their contract with the United States. This land is crossed by the portion of the main canal constructed from Indian Creek to the Deer Flat Reservoir, Payette-Boise project.

This action involves the rights of the Government under the provisions of the act of August 30, 1890 (26 Stat. L., 391), which provides that "in all patents for lands hereinafter taken up under any of the land laws of the United States or on entries or claims validated by this act west of the 100th meridian it shall be expressed that there is reserved from the said lands in said patent described a right of way thereon for ditches or canals constructed by the authority of the United States."

Subsequently another suit was filed in the same court by R. E. Green, administrator of the Taylor and Satterfield estate, against the same contractors. This case was removed by the United States attorney into the United States circuit court for this district and was set down to be heard in the September term.

A suit of some importance to the operations of the Reclamation Service is that for the adjudication of water rights from the Boise River in the case of the Farmers' Cooperative Ditch Company *v.* the Riverside Irrigation District et al. This suit was instituted in 1902 and a hydrographic survey was made by the State engineer. The case was heard in the spring of 1905 and the decision was rendered December 1, 1905 (see Pl. XLI). Further proceedings are now in contemplation in order to obtain a modification of the decree which could be applied in practice more effectually than the decree as originally rendered.

Under the laws of Idaho the costs of the suit are to be paid by the parties to whom water rights are adjudicated. The cost of the hydrographic survey by the State engineer was $10,804.60; the expenses incurred in judicial proceedings were $468.60, making a total of $11,273.20. The irrigated area to which water rights were adjudicated was 124,950 acres. The cost was therefore 9 cents per acre. As the total amount of water allotted was 2,754.8 second-feet, the cost, if computed on the basis of the water distributed, would be $4.09 per second-foot.

There are 135 parties to whom water rights were adjudicated.

EXPENDITURES.

The expenditures on the Payette-Boise project are summarized in be the following tables:

Expenditures, according to physical features, on Payette-Boise project June 30, 1906.

Features.	Engineering and administration.	Building.
Incidental structures:		
Offices, buildings, lodging houses, warehouses, corrals, etc	$150.00	$1,350.00
Irrigation structures:		
Boise River dam	2,651.00	2,761.62
Main canal	3,776.00	41,443.78
Deer Flat reservoir, lands submerged	1,041.00	62.388.00
Deer Flat, upper embankment	762.00	5,122.07
Deer Flat, lower embankment	2,606.00	17,802.71
Irrigable lands:		
Farm unit subdivision and soil examination	130.21	
Examination of project as a whole	26,162.49	
Administration of project as a whole	9,467.28	
Total	46,745.98	130,868.18
Grand total		177,614.16

Expenditures, according to purpose and nature, on Payette-Boise project to June 30, 1906.

[Total, $177,614.16.]

	Services.	Traveling.	Subsistence.	Equipment.	Materials.	Supplies.	Rent and storage.	Forage.	Job work.
Engineering:									
Examination	$12,152.80	$1,116.67	$2,026.56	$885.45	....	$639.86	$311.32	$462.70	....
Survey and inspection	12,577.71	1,071.67	2,170.40	920.74	....	709.79	....	729.29	....
Design	1,313.34	....	....	34.55	....	25.64	....	....	....
Subdivision	130.21	....	....	....	....	....	....	....	....
Building:									
Rights and property	814.48	33.00	....	....	$62,388.00	191.40	....	....	....
Building	6,816.73	528.05	532.64	1,997.47	5,984.98	2,611.25	42.23	....	$48,927.95
Administration	6,878.13	810.66	....	413.81	....	903.81	460.87	....	....

PROPOSED DUBOIS PROJECT.

Surveys and investigations of this secondary project, really the largest in the State, were practically completed in 1904, and nothing further has been done nor will likely be done toward the development of the undertaking until the other projects in the State are completed. This project provides for the reclamation of from 200,000 to 250,000 acres of land west of Dubois on the north edge of the Snake River Valley, at the western end of Fremont County, the land lying chiefly between Mud Lake and the lower end of Big Lost River. The main canal will have its head on the North Fork of Snake River near St. Anthony, and will cross the Oregon Short Line Railway near Dubois. Practically every storage basin on the North Fork and its tributaries will have to be utilized in connection with this project. A detailed description of the Dubois project is contained in the Fourth Annual Report, pages 151 to 160. The expenditures are summarized in the following table:

Expenditures, according to purpose and nature, on proposed Dubois project to June 30, 1906.

[Total, $19,489.25.]

	Services.	Traveling.	Subsistence.	Equipment.	Supplies.	Rent and storage.	Forage.
Engineering:							
Examination	$13,397.08	$1,193.74	$1,781.97	$1,711.24	$667.70	$272.83	$255.12
Administration	176.24	....	....	5.00	....	28.33	....

KANSAS.

GARDEN CITY PROJECT.

GENERAL STATEMENT.

The principal data relating to the Garden City project are summarized below:

Summary of principal data relating to Garden City project.

County: Finney.
Latitude: 37° 20′.
Longitude: 101°.
Townships: 23–34 south. Range, 32–35 west.
Irrigable area: 8,300 acres.
Kind of headworks: 23 pumping stations to recover underground water.
Duty of water: 2 feet.
Average rainfall: 20 inches.
Estimated run-off: None.
Range of temperature: Maximum, 105°; minimum, —20°.
Average elevaton: 2,925 feet.
Principal products: Sugar beets and alfalfa.
Nearest railroad: Atchison, Topeka and Santa Fe Railroad.
Nearest station: Garden City.
Principal market: Garden City.
Ownership of lands: Private.
Character of soil: Black, sandy loam; fertile.
Value of irrigated land: $50 up.
Date of completion: 1907.

The Garden City project is situated along Arkansas River, just east of Deerfield station, on the Atchison, Topeka and Santa Fe Railway, 14 miles west of the city of Garden, Kans. The irrigable areas are in the bottom lands of Arkansas River, just west of the boundary line between Kearny and Finney counties.[a] The headgates of an irrigation canal, known as the Farmers' ditch, which diverts water from Arkansas River to the uplands north and west of the city of Garden, have been constructed at this point. This canal has a maximum capacity of about 200 second-feet and is used during the irrigation season whenever there is water in Arkansas River, but the unreliability of the flow of the river at this point makes the use of the canal very uncertain. The amount of land at present entitled to water from this canal amounts to 8,600 acres, but the acreage supplied can be greatly increased, provided sufficient water is available. Water should be delivered to the lands under this project during the season of 1907. Ten of the 23 pumping units should be in operation by June 1, 1907, and the rest before the close of the season.

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[a] See Fourth Ann. Rept. Reclamation Service, Pl. XVII.

The pumping plant now being built is designed to recover an average of 100 second-feet of ground water during the irrigation season of five months, to be delivered into the Farmers' ditch about 1 mile northeast of its headgates. The pumping plant will consist of 23 separate pumping stations, each discharging into a concrete-lined flume, or surface conduit, which ultimately reaches the Farmers' ditch as described. Each pump draws water from 10 wells drilled in the gravels of the river valley.[a] The entire plant is to be driven from a central power station, located about the middle of the line of pumping plants, from which the power will be distributed electrically to the 23 separate pumping stations. The total length of the line covered by the wells and conduits of the various stations amounts to about 23,000 feet, the individual stations being spaced at intervals of 1,000 feet along the main conduit. Ten of these stations are on the north side of the river, but 13 must be built upon the south side of the river, which necessitates a crossing by an inverted siphon. Detailed description of the plant, with map and diagrams, will be found in the Fourth Annual Report of the Reclamation Service, pages 170–177.

On June 7, 1905, the underflow of Arkansas River at Deerfield, Kans., to the amount of 200 second-feet, was appropriated by Charles S. Slichter, engineer, on behalf of the United States, and notices were duly filed and posted, as required by the laws of Kansas. Work has been prosecuted continuously on this project since that date.

On October 5, 1905, the Secretary of the Interior approved the project and ordered work to begin as soon as practicable after the complete subscription, in the usual manner, of all of the lands to be benefited, in order to insure the return of the fund in accordance with the reclamation act. After the project was approved the Finney County Water Users' Association was incorporated under the laws of Kansas. This corporation received applications from the owners of about 12,000 acres of land, and contracts were approved for lands amounting to 9,625 acres. The area which it is planned to irrigate is restricted to 8,600 acres until it is ascertained whether or not sufficient water will be available for a larger acreage. About 15,000 acres can be covered by the ditch, provided sufficient water can be pumped from the underflow. Plans and specifications have been prepared for all the work that is to be done. These include the electrical power plant, the pumping apparatus, a combined residence and office building, the wells, conduits, and other necessary structures.

POWER PLANT.

On May 28, 1906, bids were opened for the electrical power plant and the contract was awarded to the D'Olier Engineering Company. This plant will consist of two De Laval steam turbines direct connected to 225 kilowatt alternators, two Stirling boilers, and a Cochrane heater. The prices bid include prime mover, alternators, switch board, and station lighting. All this machinery will be erected on foundations to be built by the Government.

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[a] See Fourth Ann. Rept. Reclamation Service, Pls. XVIII and XIX.

Bids opened May 28, 1906, for electrical power plant, Garden City project.

[Specifications No. 85.]

SCHEDULE A, STEAM TURBINE PLANT.

Bidder.	Price.	Pounds of coal used per kilowatt hour.				B. T. U. per pound of coal.
		Plant at full load.	One generator at full load.	Plant at half load.	Plant at three-fourths load.	
Jos. McWilliams & Co., Louisville, Ky	[a] $59,785	4.00	4.50	5.0	4.2	13,500
D'Olier Engineering Co., Philadelphia, Pa.[b]	46,300	5.30	5.50	5.5	5.3	10,000
D'Olier Engineering Co., Philadelphia, Pa. (alternate bid)	[c] 49,200	5.90	6.10	7.0	7.0	10,000
SCHEDULE B, RECIPROCATING STEAM ENGINES.						
Jos. McWilliams & Co., Louisville, Ky	[a] $48,424	5.00	5.50	6.0	5.5	13,500
D'Olier Engineering Co., Philadelphia, Pa	57,200	5.30	5.50	5.5	6.3	10,000
Arthur Frantzen Machine Co., Chicago, Ill	[d] 75,538	3.75	......	......	......	12,900
SCHEDULE C, GAS ENGINE PLANT.						
Westinghouse Machine Co., East Pittsburg, Pa. [b]	$86,170	3.00	3.85	3.6	3.3	11,000
Arthur Frantzen Co., Chicago, Ill. [b]	94,790	1.90	2.10	2.4	2.2	12,900

[a] Oil-burning plant, $2,680 additional.
[b] Guarantee based on lignite.
[c] Oil-burning plant, $2,970 additional.
[d] Automatic stoker, $13,500 additional.

TEST WELLS.

Seven wells, varying in diameter from 6 to 16 inches, have been drilled and provided with the same strainers proposed for the wells that will be used on this project. Extensive tests have been made to determine the capacity of the wells and the freedom with which the strainers permit the fine sand to be removed from the gravels of the water-bearing deposits. Later these wells will be connected to one of the pumping units of the completed plant.

RIGHTS OF WAY.

Necessary rights of way for the conduit line, pumping stations, power house, etc., have been secured. The rights of way in sections 11, 12, 13, and 23, were obtained from the United States Sugar and Land Company and the Finney County Farmers' Irrigation Association without expense. In section 7, 27.06 acres were obtained for $528.50. The land in section 24, amounting to 7.79 acres, was obtained for $194.75 and a parcel, 6.83 acres, in section 13 was obtained for $170.75, a total of $901.79. The assistant United States attorney for Kansas has passed upon all abstracts and holds that the Finney County Farmers' Irrigation Association, which is bound by contract to the Water Users' Association, holds good title to the entire right of way.

IRRIGABLE LANDS.

All of the lands under the Garden City project were in private ownership for years before work on this project began.

Before this project was undertaken good uplands with water rights under the farmers' ditch were quoted at from $20 to $30 per acre. During the current year (1906) lands under this project have sold for $75 per acre without the crops and $97.50 per acre with the crops. A similar appreciation has taken place in the value of bottom lands in the valley which can be developed by privately owned pumping plants. The distribution of the irrigable land is shown by the following table.

Lands included in Garden City project.

	Acres.	Percentage.		Acres.	Percentage.
GENERAL.			IRRIGABLE.		
Total	8,600		Total	8,300	
Private	8,600	100	Bottom land, Arkansas River	1,400	— 17
Public	None.		Upland	6,900	— 83
Irrigable	8,300	96	Under existing canals	8,300	+100
Nonirrigable	300	4	Above existing canals	None.	
			Subscribed	8,300	100

PRIVATE PUMPING PLANTS.

A great stimulus has been given to the construction of private pumping plants near Garden City. Information and suggestions have been freely offered private individuals who have undertaken this work. The plants have been constructed on what is known as "second bottoms," where the distance to water is 8 to 10 feet. Most of the plants are driven by 10 to 15 horsepower gasoline engines, and deliver from 500 to 1,000 gallons of water per minute.

EXPENDITURES.

The expenditures on the Garden City project are summarized in the following tables:

Expenditures, according to physical features, on Garden City project to June 30, 1906.

Features.	Engineering and administration.	Building.
Incidental structures:		
Headquarters office and superintendent's residence	$174.00	
Irrigation structures:		
Steam and electric power plant	820.00	$96.14
Transmission line	210.00	68.67
Pumping stations and wells (23)	3,004.47	590.56
Garden City conduit	2,450.00	590.57
Arkansas River siphon	430.00	27.47
Irrigable lands:		
Water Users' Association	124.65	
Examination of project as a whole	1,148.69	
Administration of project as a whole	2,127.62	
Total	10,489.43	1,373.41
Grand total		11,862.84

Expenditures, according to purpose and nature, on Garden City project to June 30, 1906.

[Total, $11,862.84.]

	Services.	Traveling.	Subsistence.	Equipment.	Materials.	Supplies.	Rent and storage.
Engineering:							
Examination	$355.15	$450.16	$219.87	....	....	$104.56	$18.95
Survey and inspection	3,135.03	417.19	806.68	$81.22	....	762.18	....
Design	1,865.00	50.76	....	18.70	....	42.87	33.49
Building:							
Rights and property	119.00	60.65	....	....	....	....	....
Building	452.72	225.01	....	82.80	$94.60	298.16	40.47
Administration	1,631.75	205.91	....	117.09	....	172.87	....

MONTANA.

HUNTLEY PROJECT.

GENERAL STATEMENT.

The principal data concerning the Huntley project are summarized below:

Summary of principal data relating to Huntley project.

County: Yellowstone.
Latitude: 46°.
Longitude: 108°.
Townships: 2 and 3 north, ranges 27 to 31 east, Montana P. M.
Average rainfall: 10 inches to 15 inches.
Range of temperature: Maximum 100°, minimum—30°.
Average elevation: 3,000 feet.
Principal products: Alfalfa, 3 crops; forage crops, hardy vegetables and fruit.
Nearest railroad: On main line of Northern Pacific Railroad and Chicago, Burlington and Quincy Railroad.
Nearest stations: Huntley, Ballantine, Pompey's Pillar.
Principal markets: Chicago, Denver, St. Paul, Butte, and Billings.
Irrigable area: 33,000 acres.
Watershed area: 11,180 square miles.
Kind of headworks: Intake from river bed.
Duty of water: 75 to 100 acres per second-foot of water.
Length of canals: 30 miles.
Length of laterals: 200 miles.
Power developed: Drop 14 miles from headworks develops 600 horsepower to furnish water for 3,000 acres and lands on Fly Creek.
Tunnels: 3, total length, 2,650 feet.
Per cent public land: 90.
Character of soil: Light, sandy loam to heavy clay.
Value of irrigated land: $75 per acre.
Beginning of survey: May, 1904.
Date of completion: 1907.

The lands under the Huntley project are situated in the Yellowstone Valley, and extend in a compact body from Huntley to Bull Mountain station, on the Northern Pacific Railway.[a] The lands are traversed by both the Northern Pacific and the Chicago, Burlington, and Quincy railways, which unite at Huntley, about 13 miles east of Billings, Mont. The irrigable tracts are about 3,000 feet above sea level. The one hundred and eighth meridian west of Greenwich intersects the forty-sixth parallel of north latitude near the historic landmark of Pompeys Pillar, 16 miles northeast of Huntley.

The main canal is taken out at the bottom level of Yellowstone River to avoid the necessity for a weir, and diverts, at normal capacity, about 400 second-feet from Yellowstone River. Filings in proper form have been made for 750 second-feet. Notice of appropriation was filed in Book E, page 106, of Yellowstone County records, on October 26, 1905. A copy of the notice of appropriation was posted October 28, 1905, near the point of diversion, and an affidavit of the posting of said notice was made and filed with the recorder for Yellowstone County March 2, 1906. The excess filed on over about 500 second-feet is for domestic use, for developing power for pumping, and for other purposes.

Yellowstone River above Billings has a drainage area of about 11,180 square miles, and has its headwaters in very high, mountainous, and timbered country. In 1904 the mean monthly discharge varied from 25,972 second-feet, in June, to 2,906 second-feet, in December. At present only a small proportion of the water in Yellowstone River is being used for irrigation or other purposes. This condition will probably be changed eventually, but the present appropriators of water are secure in their rights.

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[a] See Fourth Ann. Rept. Reclamation Service, Pl. XXVI.

A telephone system has been installed, and the necessary office buildings, lodging houses, and warehouses have been erected. The contracts in force call for the completion of the main canal and distributing system to Lost Boy Creek, a distance of about 23½ miles. An extension of the main canal from Lost Boy Creek to Bull Mountain station will be provided for later. The lateral system has been designed to deliver water to each farm unit. This has involved the building of about 250 miles of ditches of various sizes.

In the following table are listed the contracts entered into for building work on the Huntley project. This list includes all contracts for excavation, embankment, masonry, and erection of structures, but does not include materials such as cement, steel, timber, etc.

Contracts for building works on Huntley project to June 30, 1906.

Number of contract.	Contractor.	Feature.	Estimated total value.[a]	Payments to June 30, 1906.	Per cent paid.
59	W. D. Lovell	Structures	$33,764.00	$23,502.25	70
70	.....do	Main canal, division 2	43,245.00	11,976.97	28
80	Piper Bros. Co	Telephone	8,527.43	7,276.19	100
84	.....do	District system, division 1-5	116,600.00	16,997.41	15
88	Hughes & Olson	Main canal, division 1	170,360.00	12,363.89	7

[a] For a discussion of advance estimates and final costs, see page 51.

MAIN CANAL.

For the first 2 miles the canal is carried along the Huntley bluffs, and in this distance there are several sections of lined canal and three tunnels aggregating 2,650 feet in length. The tunnels will be lined with concrete and will be 9.2 feet wide and 9 feet high at the center of the arch. All important structures on the main canal, such as culverts and crossings, are built of reenforced concrete in a most substantial manner.

From Huntley eastward the canal line follows the general direction of the Chicago, Burlington and Quincy Railway to a point beyond Ballantine, where it is necessary to put in a drop of about 34 feet. This drop will be made use of by installing a pumping plant. About 240 cubic feet per second will be delivered to the vertical turbines and centrifugal pumps located on the same shaft. Sufficient power will be developed to raise about 56 cubic feet of water per second to a point 45½ feet above the main canal where it will be discharged into the high-line canal. The high-line canal will carry water to the Ballantine Bench and the canal may be extended so that it will carry water to lands along Fly Creek. The operation of the power plant is intended to be nearly automatic. The plant is simple and durable and the cost of operation and maintenance should be very low. A second drop was found to be necessary, but as the water available was much less than at the first drop, it has not been planned to utilize the power at present.

Bids for division 1 of the main canal were opened June 28, 1905. These bids are tabulated in the Fourth Annual Report, pages 212–214. The contract was awarded to Nick Hughes, the lowest bidder, who refused to execute it. It was then awarded to Griffiths & McDermott, the next lowest bidder. They also refused to execute the contract, and it was then awarded to Cotton Bros. & Co. This firm refused to enter into a contract unless the headworks provided for by the specifications were paid for at prices in excess of those quoted in their proposal. Accordingly the award of contract to Cotton Bros. & Co. was annulled, and the work was readvertised. Bids were opened January 15, 1906, and the contract was awarded to Hughes & Olson, of Butte, Mont.

Bids opened January 15, 1906, for division 1, main canal, Huntley project.

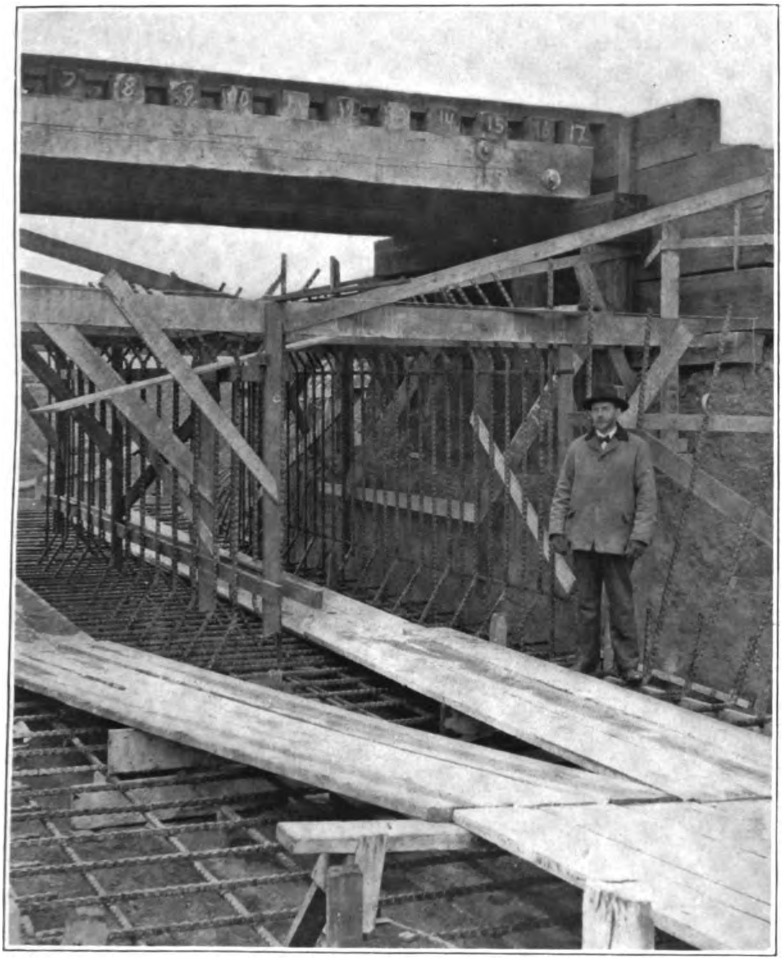
[Specifications No. 67.]

Work or material.	Quantity.	Nick Hughes and Nels L. Olson, Butte, Mont.		Billings Construction Co., Billings, Mont.		P. McDonell, Duluth, Minn.[a]	
		Unit price.	Amount.	Unit price.	Amount.	Unit price.	Amount.
Dry excavation:							
Class 1........cubic yards..	65,000	$0.20	$13,000.00	$0.50	$32,500.00	$0.25	$16,250.00
Class 2..............do....	1,000	.45	450.00	.75	750.00	.60	600.00
Class 3..............do....	16,000	1.00	16,000.00	1.10	17,600.00	1.25	20,000.00
Wet excavation:							
Class 1..............do....	13,000	.60	7,800.00	.65	8,450.00	1.00	13,000.00
Classes 2 and 3.......do....	5,000	2.50	12,500.00	2.50	12.500.00	2.50	12,500.00
Overhaul..............do....	1,000	.03	30.00	.05	50.00	.05	50.00
Tunnels:							
Type 1..............feet..	1,300	35.00	45,500.00	32.00	41,600.00	40.00	52,000.00
Type 2..............do....	500	38.00	19,000.00	38.00	19,000.00	45.00	22,500.00
Type 3..............do....	740	42.00	31,080.00	43.00	31,820.00	49.00	36,260.00
Concrete:							
Class 1.......cubic yards..	2,200	5.75	12,650.00	7.00	15,400.00	5.00	11,000.00
Class 2..............do....	1,000	9.50	9,500.00	10.00	10,000.00	7.00	7,000.00
Setting gates and appurtenances....................	4 gates.	400.00	1,600.00	300.00	1,200.00	600.00	2,400.00
Riprap...........cubic yards..	100	3.00	300.00	3.00	300.00	2.00	200.00
Rubble wall............do....	100	3.50	350.00	3.00	300.00	4.00	400.00
Paving.................do....	200	3.00	600.00	3.00	600.00	3.00	600.00
Total...................	....	....	170,360.00	....	192,070.00	....	194,760.00

Work or material.	Quantity.	Cotton Brothers & Co., Oakland, Cal.		Cook Construction Co. Des Moines, Iowa.[b]	
		Unit price.	Amount.	Unit price.	Amount.
Dry excavation:					
Class 1....................cubic yards..	65,000	$0.23	$14,950.00	$0.30	$19,500.00
Class 2..........................do....	1,000	.60	600.00	2.50	2,500.00
Class 3..........................do....	16,000	1.20	19,200.00	2.50	40,000.00
Wet excavation:					
Class 1..........................do....	13,000	.54	7,020.00	2.90	37,700.00
Classes 2 and 3..................do....	5,000	2.50	12,500.00	5.00	25,000.00
Overhaul.........................do....	1,000	.02	20.00	.03	30.00
Tunnels:					
Type 1.........................feet..	1,300	41.50	53,950.00	25.00	32,500.00
Type 2..........................do ...	500	43.50	21,750.00	31.00	15,500.00
Type 3..........................do....	740	44.50	32,930.00	30.00	22,200.00
Concrete:					
Class 1....................cubic yards..	2,200	8.50	18,700.00	6.75	14,850.00
Class 2.........................do ...	1,000	9.50	9,500.00	7.70	7,700.00
Setting gates and appurtenances...........	4 gates.	300.00	1,200.00	50.00	200.00
Riprap....................cubic yards .	100	3.00	300.00	5.00	500.00
Rubble wall......................do....	100	4.00	400.00	3.00	300.00
Paving...........................do....	200	10.00	2,000.00	6.00	1,200.00
Total..............................	....	....	195,020.00	.....	219,680.00

[a] Proposal informal; no guaranty of bond.

[b] Proposal conditional; all of division or none.



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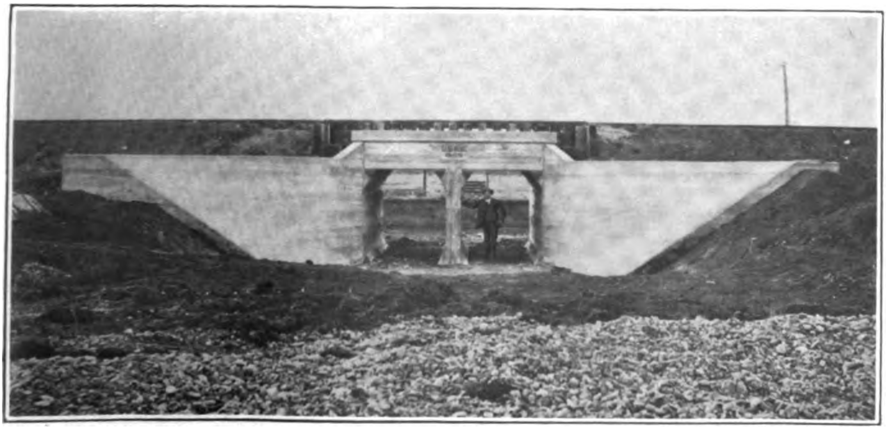

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A AND B: FIRST CULVERT ON MAIN CANAL UNDER THE CHICAGO, BURLINGTON AND QUINCY RAILROAD, HUNTLEY PROJECT, MONTANA.

Work was commenced on March 9, 1906, with a few teams. The rock cut west of tunnel 3 was started and work prosecuted vigorously until the middle of May, when high water interfered. The work of opening the tunnel portals has been started and tunnel No. 2 has been opened and about 100 feet driven. In addition there have been excavated to July 1, 1906, about 31,194 cubic yards of earth, class 1; 2,936 cubic yards of earth and rock, class 2, and 5,896 cubic yards of rock, class 3.

Bids for division 2 of the main canal were opened June 29, 1905, and are tabulated in the Fourth Annual Report, page 213. The contract was awarded to Griffiths & McDermott, but they refused to execute the contract, and it was awarded to W. D. Lovell, of Minneapolis. Work was commenced on March 26, 1906, with eight teams. Some preliminary work had already been done, including the erection of an Armstrong steam excavator. In April the excavator was started at Huntley and the grading outfit increased to 40 teams. The work has been continued at a fair rate up to July 1, at which time the contractor had excavated 115,083 cubic yards of earth, class 1.

Proposals for division 3 were opened June 28, 1905, and the contract was awarded to Griffiths & McDermott, who refused to execute it. It was then awarded to Callahan, Katz, Phelan & Shirley. These contractors, however, failed to begin work in reasonable time, and the award was annulled and the work readvertised. Bids were opened June 20, 1906, and the contract was awarded to Hughes & Olson, of Butte, Mont.

Bids opened June 20, 1906, for division 3, main canal and high line canal, Huntley project.

[Specifications No. 94.]

Kind of work.	Quantity and unit.	Hughes & Olson, Butte, Mont.		Cook Construction Co., Des Moines, Iowa.		Billings Construction Co., Billings, Mont.	
		Unit price.	Amount.	Unit price.	Amount.	Unit price.	Amount.
Excavation:	*Cubic yds.*						
Class 1	350,000	$0.22	$77,000.00	$0.23	$80,500.00	$0.29¾	$104,125.00
Class 2	100	.60	60.00	1.00	100.00	.90	90.00
Class 3	100	1.50	150.00	3.00	300.00	1.50	150.00
Riprap	100	4.00	400.00	7.00	700.00	4.00	400.00
Total			77,610.00		81,600.00		104,765.00

Bids were opened on June 28, 1905, for structures, and the contract was awarded to W. D. Lovell, of Minneapolis, Minn. The bids are tabulated in the Fourth Annual Report, page 210. Work was commenced in October, 1905, and before winter the first culvert (Pl. XLII) under the Chicago, Burlington and Quincy Railway was put in. During the winter a little work was carried on and the bridge piers put in. Early in the spring of 1906 work was begun on the culvert under the new channel of Pryor Creek, and since then the culvert under the main canal at station 272 + 30 and the Custer Coulee flume have been completed. The culverts at stations 215 + 10 and 469 and the second Chicago, Burlington and Quincy culvert are in process of construction. All the steel required for this contract has been delivered as well as the gates and guides for the work on division 1, main canal.

DISTRIBUTION SYSTEM.

During the last year plans and specifications for the distribution system were prepared and proposals were opened on December 15, 1905. Contract for schedules 1 to 5—excavation, bridges, culverts, turnouts, and other structures—was awarded to the Piper Bros. Company, of Pueblo, Colo. The grading work was started March 1, and since then the work on schedule No. 1 has progressed very well. Owing to the difficulty of securing men and teams and the delay in the delivery of lumber, the work on the other schedules is behind time.

The contract for schedule 6 was awarded to the New Jersey Foundry and Machine Company, of New York.

Bids opened December 15, 1905, for distribution system, Huntley project.

[Specifications No. 64.]

SCHEDULE 1.

Work or material.	Quantity.	The Piper Bros. Co., Pueblo, Colo.		Nick Hughes and Nels L. Olson, Butte, Mont.	
		Unit price.	Amount.	Unit price.	Amount.
Excavation:					
Class 1 ... cubic yards	141,000	$0.14	$19,740.00	$0.20	$28,200.00
Class 2 ... do	250	.38	95.00	.50	125.00
Class 3 ... do	250	.75	187.50	2.50	625.00
Ditching:					
Type 5 ... miles	65	120.00	7,800.00	200.00	13,000.00
Type 10 ... do	12	135.00	1,620.00	200.00	2,400.00
Waste-water ditches:					
Type 8 ... do	24	165.00	3,960.00	340.00	8,160.00
Type 30 ... do	11	555.00	6,105.00	1,160.00	12,760.00
Paving ... cubic yards	100	3.98	398.00	5.00	500.00
Riprap ... do	250	3.98	995.00	5.00	1,250.00
Coarse gravel ... do	200	1.25	250.00	3.00	600.00
Total			[a] 41,150.50		67,620.00

SCHEDULE 2.

Excavation:					
Class 1 ... cubic yards	115,000	$0.14	$16,100.00	$0.20	$23,000.00
Class 2 ... do	400	.38	152.00	.50	200.00
Class 3 ... do	400	.75	300.00	2.50	1,000.00
Ditching:					
Type 5 ... miles	66	120.00	7,920.00	200.00	13,200.00
Type 10 ... do	12	135.00	1,620.00	200.00	2,400.00
Waste-water ditches:					
Type 8 ... do	24	165.00	3,960.00	340.00	8,160.00
Type 30 ... do	10	555.00	5,550.00	1,160.00	11,600.00
Paving ... cubic yards	250	3.98	995.00	5.00	1,250.00
Riprap ... do	400	3.98	1,592.00	5.00	2,000.00
Coarse gravel ... do	50	1.25	62.50	3.00	150.00
Rubble wall ... do	200	3.98	796.00	5.00	1,000.00
Concrete, class 1 ... do	200	5.45	1,090.00	10.00	2,000.00
Total			[a] 40,137.50		65,960.00

[a] All of schedule or none.

Bids opened December 15, 1905, for distribution system, Huntley project—Continued.

SCHEDULE 3.

Work or material.	Quantity.	The Piper Bros. Co., Pueblo, Colo.		Midland Bridge Co., Kansas City, Mo.	
		Unit price.	Amount.	Unit price.	Amount.
Bridges, Type I:					
26-foot span, complete	2	$81.00	$162.00	$143.50	$287.00
24-foot span, complete	4	74.00	296.00	135.24	540.96
22-foot span, complete	17	70.00	1,190.00	125.56	2,134.52
20-foot span, complete	8	66.00	528.00	120.25	962.00
18-foot span, complete	8	62.00	496.00	113.44	907.52
16-foot span, complete	20	56.00	1,120.00	104.17	2,083.40
14-foot span, complete	4	52.00	208.00	94.43	377.72
12-foot span, complete	20	48.00	960.00	87.48	1,749.60
Bridges, Type II:					
10-foot span, complete	4	38.00	152.00	76.60	306.40
8-foot span, complete	4	34.00	136.00	66.58	266.32
6-foot span, complete	4	30.00	120.00	54.10	216.40
Excavation, class 1 ... cubic yards	4,000	.40	1,600.00	.93	3,720.00
Sill stones, 12 feet by 18 by 18 feet	80	1.00	80.00	1.00	80.00
Concrete, class 1 ... cubic yards	300	5.45	1,635.00	9.00	2,700.00
Total			[a] 8,683.00		16,331.84

SCHEDULE 4.

Culverts:					
Type 0 (class 2 lumber) ... feet B. M.	24,500	[b] $29.60	$725.200		
Type 00 (class 2 lumber) ... do	70,000	[b] 29.60	2,072.000		
Type 000 (class 2 lumber) ... do	95,000	[b] 29.60	2,812.000		
Turnouts:					
Type 11, 12, 21, 22, 21R, 22R, 1121, 2111 (class 2 lumber) ... feet B. M.	32,500	[b] 31.75	1,031.875		
Type 31 and 32 (class 2 lumber) ... do	4,800	[b] 31.75	152.400		
Wooden gates, etc. (class 1 lumber, dressed) ... feet B. M.	3,000	[b] 36.00	108.000		
Type 41 (class 2 lumber. ... do	23,100	[b] 31.75	733.425		
Type 51 (class 2 lumber) ... do	104,000	[b] 31.75	3,302.000		
Trestling (class 1 lumber) ... do	5,000	[b] 34.50	172.500		
Trestling (class 2 lumber) ... do	2,000	[b] 30.00	60.000		
Preserving lumber ... do	300,000	[b] 1.25	375.000		
Excavation, class 1 ... cubic yards	3,000	.40	1,200.000		
Puddling ... do	1,000	.75	750.000		
Paving ... do	100	3.98	398.000		
Riprap ... do	50	3.98	199.000		
Flashboards	175	1.35	236.250		
Coarse gravel ... cubic yards	20	1.25	25.000		
Concrete, class 1 ... do	200	5.45	1,090.000		
Total			[a] 15,442.65		

SCHEDULE 5.

Concrete:					
Class 1 ... cubic yards	100	$5.45	$545.00		
Class 2 ... do	800	10.00	8,000.00		
Setting gates and guides:					
Type A	20	2.25	45.00		
Type B	13	2.25	29.25		
Setting lifting devices	20	2.25	45.00		
Excavation:					
Class 1 ... cubic yards	400	.40	160.00		
Class 2 ... do	100	.55	55.00		
Class 3 ... do	100	.85	85.00		
Puddling ... do	200	.75	150.00		
Paving ... do	150	3.98	597.00		
Riprap ... do	200	3.98	796.00		
Rubble walls ... do	50	3.98	199.00		
Coarse gravel ... do	80	1.25	100.00		
Vitrified pipe:					
15-inch ... linear foot	200	.90	180.00		
4-inch ... do	1,000	.20	200.00		
Total			[a] 11,186.25		

[a] For complete schedule, and at least one other schedule.

[b] M feet B. M.

Bids opened December 15, 1905, for distribution system, Huntley project—Continued.

SCHEDULE 6.—F. O. B. HUNTLEY, MONT.

Work or material.	Quantity.	New Jersey Foundry and Machine Co., New York, N. Y.	
		Unit price.	Amount.
Steel for concrete reinforcement:			
Plain bars .... pound..	50,000	$0.0320	$1,600.00
Patent bars .... do....	20,000	.0430	860.00
Gates and guides:			
Type A .... do....	6,000	.0850	510.00
Type B, complete	13	17.0000	221.00
Ratchet lifting devices, complete	20	37.0000	740.00
Structural steel .... pound..	178,000	.0374	6,657.20
Total			10,588.20

The only material so far received has been the hold-down bolts for steel bridges. It is expected that the structural steel for the bridges and the reenforcing steel will be shipped soon. No payment has been made on this contract.

TELEPHONE SYSTEM.

Bids for a telephone system were opened December 15, 1905, and the contract was awarded to the Piper Brothers Company, of Pueblo, Colo. Some material was received within thirty days, but work was delayed by the difficulty of securing poles. The first car of poles arrived March 27, and from that time the construction work proceeded rapidly to the completion of the contract on May 20. The system installed is well built and is giving satisfactory service. It consists of 22.7 miles of two-wire metallic circuit line with eight stations distributed over the project.

Bids opened December 15, 1905, for telephone system, Huntley project.

[Specifications No. 65.]

Kind of work.	Quantity.	The Piper Bros. Co., Pueblo, Colo. [a]		W. H. Crumb & Co., Chicago, Ill.	
		Unit price.	Amount.	Unit price.	Amount.
Section I: Pole line and circuit .... miles..	22	$294.49	$6,478.78	$304.00	$6,688.00
Section II: Furnishing and installing apparatus (if section I is awarded)			226.51		150.00
Section III: Furnishing and installing extra apparatus .... stations..	2	27.60	55.20	20.00	40.00
Total for sections I, II, and III			6,760.49		6,878.00
Section II: Furnishing and installing apparatus (if section I is not awarded)					450.00
Total for sections II and III only					490.00

Bids opened December 15, 1905, for telephone system, Huntley project—Continued.

Kind of work.	Quantity.	Simpson & Riddle, Boise Electrical Supply Co., Ltd., Boise, Idaho.[a]		W. D. Lovell, Minneapolis, Minn.	
		Unit price.	Amount.	Unit price.	Amount.
Section I: Pole line and circuit..........miles..	22	$342.00	$7,524.00	$351.00	$7,722.00
Section II: Furnishing and installing apparatus (if section I is awarded)..........			176.00		361.00
Section III: Furnishing and installing extra apparatus..........stations..	2	22.00	44.00	50.00	100.00
Total for sections I, II, and III..........			7,744.00		8,183.00
Section II: Furnishing and installing apparatus (if section I is not awarded)..........					400.00
Total for sections II and III only..........					500.00

[a] Will not accept section II unless awarded section I.

CEMENT.

Bids for cement were opened September 5, 1905, and the contract was awarded to the Illinois Steel Company for $1.10 per barrel f. o. b. cars Chicago, Ill. Only one bid in proper form was received. The cement delivered under this contract has been satisfactory and has been shipped promptly as required.

IRRIGABLE LANDS.

The land slopes gently to Yellowstone River, which forms the north boundary of the project, and will be readily brought under cultivation, except an area of about 5,000 acres which contains so much alkali that it is believed to be necessary to flood it for a season before crops can be started.

The lands under this project were formerly within the ceded strip of the Crow Indian Reservation. The Reclamation Service has developed the project according to the terms of the act of April 27, 1904, under which settlers will have to pay $4 for the lands in addition to the cost of reclamation. At the time of entry $1 per acre will be paid and the remainder will be paid in four equal annual installments, the first installment being due at the end of the second year. Upon all entries the usual fee and commissions shall be paid, as provided for in the homestead laws, the price of which is $1.25 per acre.

About 20,000 acres will be irrigated in 1907, and by the extension of the main canal and high-line canal and the reclamation of some alkali land it is expected that in 1908 about 33,000 acres will be under cultivation. The approximate extent of the lands is given in the following table.

Land included in the Huntley project.

	Acres.	Percentage.		Acres.	Percentage.
GENERAL.			IRRIGABLE.		
Total withdrawn area	58,080	....	Total	33,000	....
Allotted lands	4,360	7.50	Under main canal west of Lost Boy Creek	26,200	79.39
Public lands	53,720	92.50	Under High Line Canal	2,700	8.18
Irrigable lands	33,000	56.90	Under proposed extensions	4,100	12.42
Nonirrigable lands	25,080	43.10			
ALLOTTED.			NONIRRIGABLE.		
Total	4,360	....	Total	25,080	....
Irrigable	3,300	75.69	Included in farms under main canal west of Lost Boy Creek	6,000	23.92
Nonirrigable	1,060	24.31	Included in farms under High Line Canal	2,700	10.77
PUBLIC.					
Total	53,720	....	Included in farms under proposed extension	4,000	15.94
Irrigable	29,700	55.20	Withdrawn area adjacent to farms	12,380	49.37
Nonirrigable	24,020	44.80			

EXPENDITURES.

The expenditures on the Huntley project are summarized in the following tables:

Expenditures, according to physical features, on Huntley project to June 30, 1906.

Features.	Engineering and administration.	Building.
Incidental structures:		
Telephone line, 22.7 miles	$189.38	$7,276.19
Offices, cottages, lodgings and boarding houses, warehouses, corrals, etc.	375.99	12,533.15
Irrigation structures:		
Main canal	16,464.84	16,194.44
Main canal structures	11,726.68	21,866.80
Distributing system	8,232.42	8,680.55
Irrigable lands:		
Farm unit subdivision and soil examination	6,921.20	....
Examination of the project as a whole	3,890.02	....
Administration of the project as a whole	8,829.54	....
Total	56,630.07	66,551.13
Grand total	....	123,181.20

Expenditures, according to purpose and nature, on Huntley project to June 30, 1906.

[Total, $123,181.20.]

	Services.	Traveling.	Subsistence.	Equipment.	Materials.	Supplies.	Rent and storage.	Forage.	Job work.
Engineering:									
Examination	$3,120.54	$588.43	$13.69	$13.05	....	$308.93	$26.76	$8.00	....
Survey and inspection	15,892.56	1,888.48	5,190.41	4,079.29	....	1,985.93	17.23	1,019.35	....
Design	6,142.74	102.71	200.96	219.25	....	61.02	....	....	....
Subdivision	5,854.49	87.54	819.27	64.05	....	28.54	....	67.31	....
Building:									
Rights and property	60.00	36.61	....	....	....	2.00	....	....	....
Building	5,646.15	566.24	1,308.48	1,861.10	$2,739.25	1,500.92	41.50	580.12	$52,208.76
Administration	6,343.33	772.87	....	698.67	....	988.57	26.10	....	....

MILK RIVER PROJECT.

GENERAL STATEMENT.

A summary of the principal data relating to the Milk River project is given below:

Summary of data relating to Milk River project, Montana.

State: Montana.
Counties: Chouteau, Valley.
Latitude: 48° 30′.
Longitude: 107° 110°.
Township: 3–40 east, range 27–34 north.
Irrigable area: 200,000 acres, extending 150 miles along valley of Milk River.
Average rainfall: 13½ inches.
Estimated run-off: 1 inch.
Range of temperature: Maximum, 105°; minimum, 45°; mean, 42°.
Average elevation: 2,000 to 2,400 feet.
Principal products: Hay, forage, grains.
Nearest railroad: Great Northern.
Nearest station: 32 stations throughout the project.
Principal market: Local.
Per cent public land: 50.
Character of soil: Sandy loam and gumbo.
Value of irrigated land: $35 to $40.
Capacity of reservoirs: 587,000 acre-feet.
Duty of water: 2 feet.
Length of canals: Total, 500 miles.

The location and extent of the Milk River project were described in the First Annual Report of the Reclamation Service, pages 203 to 214; in the Second Annual Report, pages 332 to 350; in the Third Annual Report, second edition, pages 291 to 307; and in the Fourth Annual Report, pages 177 to 188. A general map of the project was published in the Third Annual Report, second edition, Pl. XXVIII.

In northern Montana and southern Alberta are two rivers, Milk and St. Mary, whose drainage basins are partly in the United States and partly in Canada. Canals have been diverting water from each river for several years past, and certain vested rights have thus been acquired. St. Mary River rises on the eastern slope of the Rocky Mountains in Montana and flows northward into Canada, where it empties into Saskatchewan River, its waters being eventually lost in Hudson Bay. Milk River has its source in the United States in the rolling country lying immediately east of the St. Mary basin. Its two forks, North Fork and South Fork, flow northward into Canada, where they unite, thence continuing as Milk River proper in an easterly direction for about 100 miles, and then reentering the United States. Milk River finally empties into Missouri River.

The valley of lower Milk River ranges in elevation from 2,100 to 2,500 feet, and is well adapted for irrigation if the water supply were sufficient. Milk River is deficient in this particular, and it is proposed to store the flood waters of St. Mary River, divert them into the headwaters of Milk River, and utilize this water on the irrigable lands of lower Milk River in Montana. Plans are now being made in both countries for larger irrigation works, whereby ultimately the water supply of both rivers will be utilized, and it will probably be necessary for the United States and Canada to make an agreement relative to a division of the water of both streams.

The surveys have brought out three methods of utilizing the waters of St. Mary basin: (1) By diverting St. Mary River to North Fork of Milk River and allowing it to run through Canada to lower Milk River Valley in Montana; (2) by utilizing the waters on the eastern section of the Blackfeet Indian Reservation and on the lands adjacent to the east; (3) by carrying the St. Mary water across both the North and South forks of Milk River to Cutbank drainage, allowing it to flow down this and Marias River, 100 miles or more, then divert it from the Marias by a canal to Big Sandy Creek, a tributary of Milk River.

The most feasible plan is the one first mentioned. The second one can also be carried out. The third method has been considered in previous reports as a possible connecting link between the St. Mary basin and lower Milk River, but from the detailed investigation on Marias River during 1904, it is believed that this diversion should be considered on its own merits—that is, as a scheme to make the Marias a separate source of irrigation for lands immediately west of the Big Sandy Creek.

On March 25, 1905, an allotment of $1,000,000 was made to build the St. Mary canal from St. Mary River to the North Fork of Milk River, a distance of 25 miles. No allotments have been made, or authorization given for the construction of any portions of the works in the lower Milk River Valley.

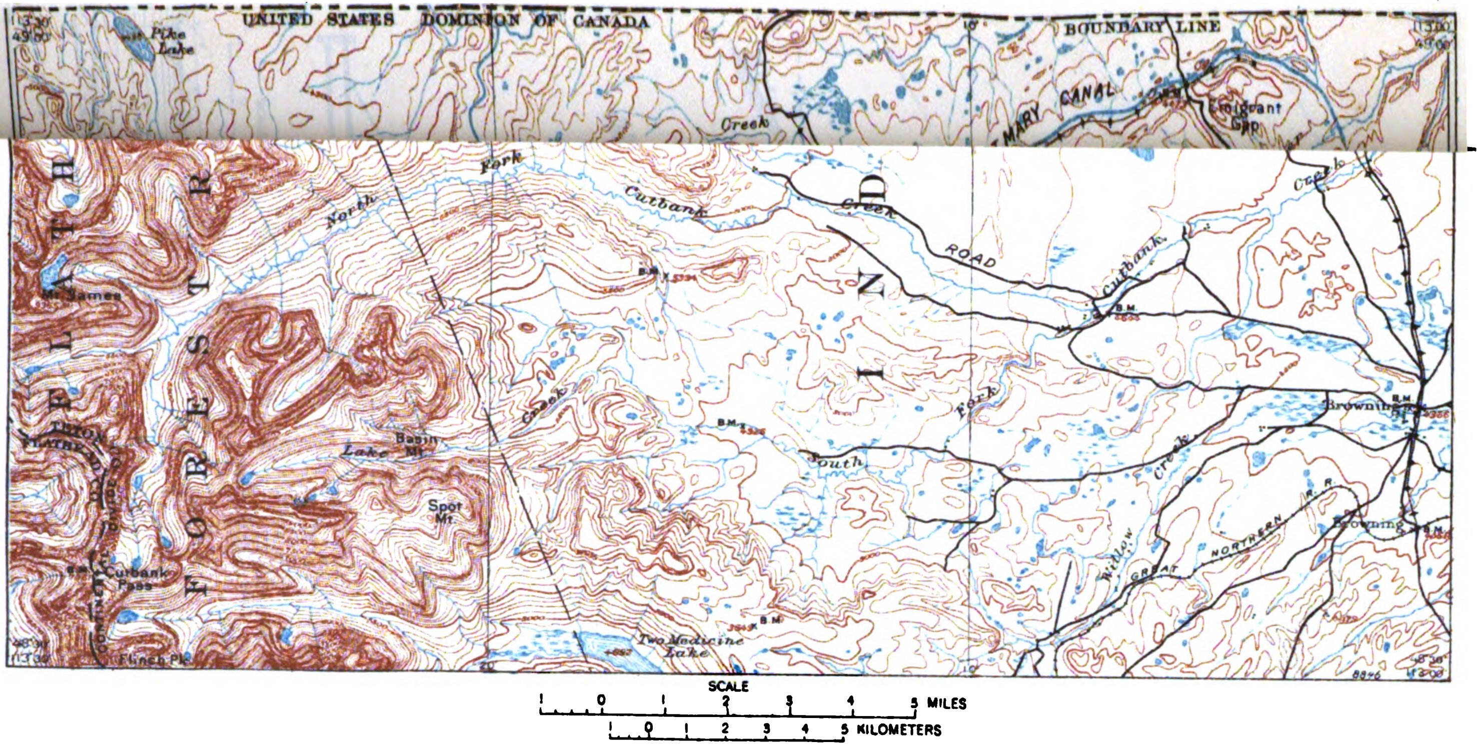
ST. MARY BASIN.

The final location of the St. Mary canal (Pls. XLIII and XLIV), capacity 850 second-feet, was commenced early in the spring of 1906, before the snow was off the ground. By the end of the fiscal year the canal was located and practically cross-sectioned.

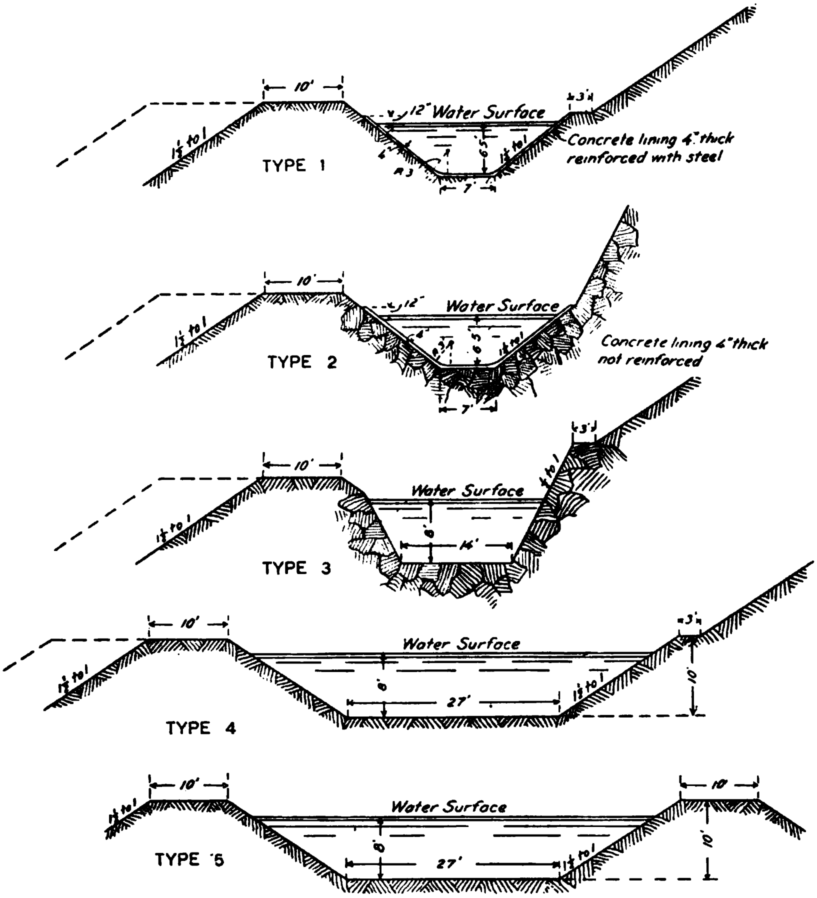
Specifications were prepared and bids requested for divisions 1, 2, and 3, or the first 15 miles of the canal. These proposals are for the excavation only of that section and the lining by concrete of about 14,000 feet of the canal prism. Arrangements have been made with the Indian Office for the building of division 4 of the canal, or the last 8 miles, by the employment of Indians on force account work.

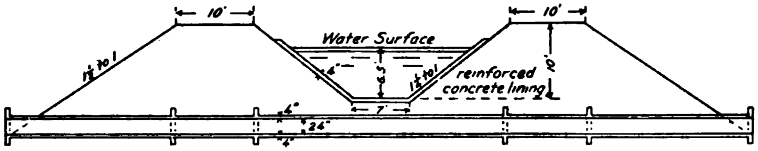
A portable sawmill has been established at the foot of Lower St. Mary Lake and a contract entered into with local parties for the delivery of 200,000 feet B. M. of timbers at the sawmill. A little lumber was cut during the last few days of the fiscal year. The timber will be obtained from the Lewis and Clarke Forest Reserve, under provisions of existing law, which provides for the cutting of timbers on forest reserves free of charge, for Government purposes.

The St. Marys International Telephone Company has been organized for the purpose of constructing and operating a telephone line from Browning to St. Mary River. The right of way on the Blackfeet Indian Reservation has been allowed by the Commissioner of Indian Affairs. This line, total length 36 miles, is being built mainly for the use of the Reclamation Service, and a contract has been entered into with the company for the rental of a number of instruments.

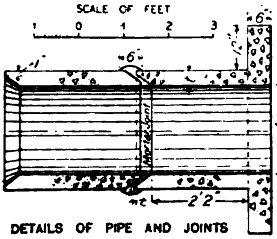


GENERAL MAP ST. MARY BASIN, MONTANA.



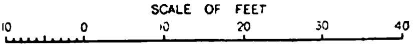


TYPICAL CROSS SECTION OF CANAL
SHOWING DRAIN PIPE IN POSITION.



DETAILS OF PIPE AND JOINTS

d	t
in	in
18	3½
24	4
30	5
36	6



HYDRAULIC DATA

Sec	Bottom width	Depth Feet	Area Sq ft	Side Slope	Velocity Ft per sec	Slope	Discharge Sec Feet
1	7'	6.5	98.	1¼ :1	8.66	00125	850
2	7'	6 5	98.	1¼ .1	8 66	125	
3	14'	8 0	144	½ :1	5.80	125	
4	27'	8.0	312.	1½ 1	2.70	020	
5	27'	8.0	312	1½ .1	2 70	020	

8605

CROSS SECTIONS OF THE ST. MARY CANAL, ST. MARY BASIN, MONTANA.

LOWER MILK RIVER BASIN.

A detailed account of the past operations and surveys in this section was given in the Fourth Annual Report, pages 181 to 185. No surveys have been carried on since.

During the spring of 1906 extraordinary floods occurred in the valley of Milk River and its tributaries. After their subsidence a party was placed in the field, examining all drainage ways and estimating their flood discharge. These data will be used in future computations for canal crossings.

Milk River was unusually low in the early spring of 1906, at the time the private canals in the vicinity of Chinook and Harlem desired to use water for irrigation. An unsettled lawsuit was on hand for the adjudication of the various rights, but no canal company knew the quantity of water to which it was entitled. By a recent decision of the Federal court, the Fort Belknap Indians were entitled to 5,000 miners' inches, or 125 second-feet. The various private canal companies appointed one delegate each to form an executive committee, and they petitioned the local office of the Reclamation Service at Chinook to divide and regulate the water of Milk River between the various companies. The Indian agent of the Fort Belknap Reservation said for that season he would be satisfied with 2,500 inches, or 62.5 second-feet. He was to have first right to this amount, the balance to be divided between the private companies.

The Reclamation Service has had for a number of years gaging stations on Milk River and a number of its tributaries and was ready to assist the settlers in such a division. The executive committee in question arranged for a daily service for the delivery of gage height reports on streams and canals to the office of the Reclamation Service. This was done through the use of telephone lines and in other ways.

The executive committee also wished the Reclamation Service to take control of the regulation of the gates of the various canals, but this request was refused. Daily reports were made, however, as to the amount of water that each canal was entitled to and the corresponding height that the various gage rods in the canals should read. The various canal companies lived up to their agreement in this particular and the service was satisfactory for a while, or until the flow of Milk River so increased that there was a surplus above the needs of all canals. At this time these arrangements were abandoned.

The methods and table of percentages for the division of water were based on the measurements of the Reclamation Service. The district engineer in charge urged upon the committee that the basis of area irrigated by the various canals be adopted. The committee refused to adopt this, however, and instead voted to adopt a percentage based on the maximum capacities of the various canals. There was only a few per cent difference in either method, and the latter was therefore adopted.

The following table shows the various canals; the areas irrigated under each; their maximum capacities; and the per cent of the water of Milk River and tributaries to which each was entitled. From the total amount of water available there was to be deducted for the Indian Reservation 2,500 miners' inches, the balance remaining to be divided among the other canals in accordance with percentages given in the table on the next page.

Capacities and percentages of private canals, Milk River Valley, Montana.

Canal.	Area irrigated.	Maximum capacity.	Percentage.
	Acres.	*Second-feet.*	
Belknap	10,900	130	37
Paradise	1,400	19	5
Harlem	7,820	73	21
Winter-Anderson	440	12	3
Cook	2,700	50	14
Matheson	1,715	28	8
Dowen	40	7	2
Rokita	40	6	2
Corregan	55	6	2
West Fork	800	13	4
Reservation	240	8	2
Total	26,150	352	100

IRRIGABLE AREA.

The Milk River project as surveyed includes over 250,000 acres, divided into two divisions: (1) 91,000 acres near Chinook and Harlem; (2) 159,000 acres extending from the Dodson diversion dam eastward to Glasgow. The water supply, however, may not be sufficient for more than 175,000 acres. The range in altitude is from 2,000 to 2,400 feet above sea level. Under the alternative scheme of using the waters of the St. Mary River on lands in the eastern part of the Blackfeet Indian Reservation and on the lands immediately adjacent to the east, 100,000 acres are available. The range in altitude is from 3,700 to 4,200 feet above sea level. From a diversion of Cutbank Creek, on the Blackfeet Indian Reservation, 24,000 acres are available for irrigation. The approximate distribution of the irrigable lands is shown by the following table:

Distribution of lands, Milk River project.

	Acres.	Per cent.
GENERAL.		
Total	250,000	
Private	121,000	48
Public	129,000	52
Irrigable	215,000	86
Nonirrigable	35,000	14
In Chouteau County	106,800	43
In Valley County	143,200	57
Under Chinook or upper system	91,000	36
Under Dodson or lower system	159,000	64
CHINOOK SYSTEM.		
Total	91,000	
Private	38,000	42
Public	53,000	58
In Chouteau County	91,000	100
Irrigable	77,000	85
Nonirrigable	14,000	15
On Fort Belknap Indian Reservation	33,000	36
CHINOOK SYSTEM—continued.		
Irrigated from private canals	25,000	27
Under proposed north canal	43,000	47
Under proposed south canal	48,000	53
DODSON SYSTEM.		
Total	159,000	
Private	83,000	52
Public	76,000	48
Irrigable	143,000	90
Nonirrigable	16,000	10
Private holdings subscribed—		
In Chouteau County	15,800	10
In Valley County	143,200	90
Under Malta south canal	20,700	13
Under Malta north canal	14,000	9
Under Beaver Creek branch	13,900	9
Under Bowdoin north canal	46,200	29
Under Bowdoin south canal	48,400	30
Under Hinsdale branch	13,700	9
Under Mud Lake branch	2,100	1

EXPENDITURES.

The expenditures on the Milk River project are summarized in the following tables:

Expenditures, according to physical features, on Milk River project to June 30, 1906.

Features.	Engineering and administration.	Building.
Incidental structures:		
Browning-St. Mary road, including bridges improved, 36 miles		$10,113.49
Sawmill		1,664.46
Headquarter's office, Browning, Mont		1,675.13
Irrigation structures:		
St. Mary dam	$7,629.43	
St. Mary main canal	3,858.20	
Distribution system—		
Chinook diversion	4,900.00	
Dodson diversion	28,974.36	
Marias diversion	9,999.38	
Irrigable lands:		
Farm-unit subdivision and soil examination	68.09	
Water users' association		
Examination of project as a whole:		
St. Mary basin	20,506.78	
Marias project	3,361.14	
Lower Milk River	31,621.29	
Administration of project as a whole:		
St. Mary basin	8,047.12	
Marias project	587.77	
Lower Milk River project	19,992.94	
Total	139,546.50	13,453.08
Grand total		152,999.58

Expenditures, according to purpose and nature, on Milk River project to June 30, 1906.

[Total, $152,999.58.]

	Services.	Traveling.	Subsistence.	Equipment.	Materials.	Supplies.	Rent and storage.	Forage.
Engineering:								
Examination	$27,298.92	$5,597.58	$10,249.69	$5,500.29	$28.40	$3,842.45	$198.00	$1,089.61
Survey and inspection	29,543.92	3,965.61	11,713.16	2,472.40		2,525.40	54.16	2,024.09
Design	4,421.18	113.86		118.90		84.52	8.44	
Subdivision	53.53	3.26		4.66		5.70	.94	
Building	7,113.67	80.49	1,328.43	1,949.02	2,333.96	620.76		26.75
Administration	19,102.81	4,257.36	1,476.99	1,359.00		1,532.97	550.61	348.09

SUN RIVER PROJECT.

GENERAL STATEMENT.

The country comprised in the Sun River project lies between the Rocky Mountains on the west, Missouri River on the east, Teton River on the north, and Dearborn River on the south. The valley of Sun River proper is from 1 to 3 miles wide, and the river runs from 5 to 25 feet below its general surface. This valley is bordered by bluffs about 300 feet in height, and the area between these bluffs and the adjoining river valleys is comparatively smooth bench land. The altitude at Great Falls is 3,300 feet above sea level and at the canyon where the river leaves the mountains it is 4,450 feet.

The land in the valley has been largely irrigated, and the ordinary summer flow of the streams is practically all utilized. The general plan now contemplated is to store the flood waters and carry them to these higher bench lands. The amount of water available averages about 570,000 acre-feet annually.

The Reclamation Service made a general reconnaissance of the lands lying between Sun and Teton rivers. It was discovered that there was a very large area of excellent irrigable land in that region, much more than could be reclaimed by the available water supply, and all the plans that have been since considered in connection with this part of the project have had in view the ultimate extension of the canal system to cover such additional lands as future use of the water may show to be available.

In 1905 preliminary surveys were made to determine what lands are available on the south side of Sun River. These surveys were carried across the divide between the Sun and Missouri into the basin of Muddy Creek and down the Missouri flats in the vicinity of Cascade and Ulm.

It was found that the lands south of Sun River are much rougher than those on the north side and that the cost per acre irrigated would be greater. The status of land affected in some cases was unsatisfactory, as the owners of private lands were disinclined to favor a new canal to be built by the Reclamation Service, and there are about 30,000 acres of land—the reclamation of which was undertaken under the Carey Act—which are in a very unsatisfactory condition from a legal standpoint. Consequently all idea of reclaiming land on the south side of the river has been abandoned with the exception of about 15,000 acres on and in the vicinity of the abandoned Fort Shaw Military Reservation, the details concerning which are mentioned below.

Location surveys were made on the north side for the Supply canal, the High line, and Teton slope canals. Surveys were also made of storage reservoirs in connection with the entire project and three sites determined upon: (1) Warm Springs, in the mountains above the diversion on the North Fork; (2) Pishkun, on the bench about 15 miles from the mountains; (3) Willow Creek, on the south side. The Pishkun reservoir will supply the High line and Teton slope canals, and the Willow Creek reservoir will supply Fort Shaw and private appropriations and provide for the use of the low-water flow of the North Fork. The supply canal from the North Fork to Willow Creek reservoir was also located for a distance of 8 miles. Detailed surveys were made of reservoirs, and diamond drillings were made for the determination of the geological conditions to be encountered in building the structures.

The important structures on this project will include a rock fill dam at Warm Springs that will be 213 feet high and 762 feet long on top. The outlet to this reservoir will be a tunnel through solid rock. The diversion weir at the canyon will be a reenforced concrete dam 72 feet high and 150 feet long on top. There will be 5 tunnels, having a total length of 11,030 feet.

On the Teton slope line there will be two important pressure pipes. One at Priest Butte Sag will be 4,400 feet in length and 9¼ feet in diameter, and one at the crossing of the Montana and Great Northern Railroad will be 3,400 feet in length and 6 feet in diameter. On the Fort Shaw distributing system there will be a pressure pipe across Simms Creek 1,500 feet in length by 5 feet inside diameter. The Willow Creek dam will be of earth 110 feet high with a steel-concrete core outlet conduit. At the Pishkun reservoir the water is to be divided; part will go through the High line canal and part through the 430-foot tunnel into natural channels, through which it finds its way to the head of the Teton slope canal on Deep Creek. Details of the surveys, reservoir capacities, and other features are given in the Fourth Annual Report of the United States Reclamation Service, pages 215 to 224.

Owing to the uncertainty as to whether the bill for the opening of the abandoned Fort Shaw Military Reservation would pass Congress and thereby allow that subproject to be taken up as the first unit it was necessary to prepare for another place of beginning. Consequently, additional detailed plane-table sheets were prepared of the North Fork canyon to be used in connection with designing the diverting dam, headworks, and upper portal of tunnel No. 1. Before the completion of these sheets the uncertainty about being able to start at Fort Shaw was removed, and upon their completion all work upon the north side was stopped, and nothing has since been done thereon.

FORT SHAW UNIT.

The following bill opening the Fort Shaw Reservation to settlement was approved June 9, 1906:

> *Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled*, That the Secretary of the Interior is hereby authorized to dispose of the lands in the abandoned Fort Shaw Military Reservation, in Montana, under the provisions of the public land laws, and the public land surveys shall be extended over the lands therein: *Provided*, That he may reserve for Indian school purposes the following-described lands in township twenty north, range two west, Montana principal meridian, as determined by the extension of the public surveys: That portion of section two lying south of Sun River, all of sections eleven, fourteen, and twenty-three, and that portion of section twenty-six lying within the present reservation boundary: *Provided further*, That before opening the reservation to entry the Secretary of the Interior may withdraw any other lands therein needed in connection with an irrigation project under the provisions of the act of June seventeenth, nineteen hundred and two, known as the reclamation act, for use or disposition thereunder.

As soon as it was known that this tract would be available, preliminary canal surveys were begun for the distributing system, and the main canal line was located. This canal heads in the SE. ¼ sec. 2, T. 20 N., R. 4 W.; thence it runs eastward on the south side of Sun River, crosses Simms Creek, and enters the reservation about 7½ miles from its head. It will carry water to all the irrigable land in the reservation south of the river and to about 1,200 acres of a very desirable bench to the east. A lateral 2½ miles in length has been run to cover about 1,000 acres of bottom land to the east. Before the canal reaches the reservation it will carry water to about 900 acres available for reclamation, making a probable total of 18,100 acres irrigable under the first unit.

The topographic survey of the irrigable land is nearly completed. The smoother part of the area has been mapped on a scale of 400 feet to the inch, with 2-foot contours, and the hillsides on 1,000 feet to the inch, with 5-foot contours. From this survey the sublaterals and farm units will be planned and laid off. About one-third of the irrigable land is so situated that the laterals may follow the subdivision lines, and for this reason the whole system can not be intelligently planned until section lines are established. The topography has been mapped in detail at points where important structures occur, viz, headworks, wasteway, and Simms Creek crossing.

Two meetings of the present landowners have been held preliminary to the formation of a water users' association, and it seems probable that all the private land affected will be subscribed. The total private land is only 11 per cent of the project.

WILLOW CREEK RESERVOIR.

As the minimum run-off, obtained in 1905, shows that, after prior appropriations are served, there may be a shortage of natural flow for the Fort Shaw lands, it has been decided to build Willow Creek dam to a height of 70 feet to store the discharge of that creek. As described in the Fourth Annual Report, the ultimate intention is to build the dam to a height of 110 feet, with a capacity of 84,320 acre-feet, the supplemental supply coming from North Fork. The present plan will give 16,700 acre-feet storage, and a minimum run-off of 10,000 acre-feet has been measured in Willow Creek. The dam will utilize a natural spillway that will require little or no artificial protection.

In the fall of 1905 three drill holes were sunk at this dam site and sandstone bed rock was reached at depths of 10½, 12, and 25 feet, after going through gravel and tough clay. Designs for dam and structures are being prepared. The dam will be of earth and an abundance of material for its construction, for riprap, and for concrete is available immediately adjacent to the site. The outlet pipe, gatehouse and tower will be of reenforced concrete.

When the north side system is constructed it will be necessary to raise the dam to its full height to obtain the maximum storage capacity, as the Warm Springs and Pishkun (formerly called Stone Johnnie) reservoirs will not entirely control the floods. The 8 miles of supply canal will have to be dug and the extra storage will be used to supply the prior rights downstream so that North Fork's low water flow may all be used to the north.

It will be necessary to purchase 520 acres of land that will be flooded, and negotiations for this have been entered into. Two hundred acres more will be taken under the act of August 30, 1890 (26 Stat. L., 391), and the remaining 1,565 acres are reserve lands for reservoir purposes still vacant. The dam site is on reserved lands, so any delay in securing the other lands will not hinder work on the dam.

ADJUDICATION OF WATER RIGHTS.

The adjudication of water rights on Sun River and its tributaries begun in October, 1905, has been pushed. Two parties under the State engineer continued their field work during the winter, and made surveys of each and every canal and ditch deriving its supply from any water flowing into Sun River. These surveys showed not only the ditches, but all lands below them, subdividing them into nonirrigable, irrigable, and irrigated, showing acreage and location. The kinds of crops, area, etc., were also shown. Measurements of size and calculations of capacity were also made and tabulated. All this information has been put in possession of the court, as have also the results of gagings of discharge of all ditches carrying water. Consequently the basic facts as to use and possibilities are all in shape to be used. All parties to the suit have either made their answers or have stipulated to abide by their amounts as determined by the State engineer. There seems to be no reason why an early decree in the case may not be entered.

EXPENDITURES.

The expenditures on the Sun River project are summarized in the following table:

Expenditures, according to physical features, on Sun River project to June 30, 1906.

Features.	Engineering and administration.	Building.
Incidental structures:		
Offices, lodging and boarding houses, warehouses, stables, etc	$153.90	....
Irrigation structures:		
Willow Creek reservoir, dam, etc	3,450.16	....
Fort Shaw main canal	4,354.31	$48.80
Distributing system	2,902.87	....
Irrigable lands:		
Farm unit subdivision and soil examination	103.22	....
Examination of project as a whole	39,312.95	....
Administration of project as a whole	9,820.83	....
Total	60,098.24	48.80
Grand total	....	60,147.04

Expenditures, according to purpose and nature, on Sun River project to June 30, 1906.

[Total, $60,147.04.]

	Services.	Traveling.	Subsistence.	Equipment.	Supplies.	Rent and storage.	Forage.
Engineering:							
Examination	$15,206.47	$1,115.76	$3,393.23	$2,635.19	$829.72	$51.41	$1,875.42
Survey and inspection	14,509.80	1,643.32	3,160.04	1,938.11	1,238.31	119.29	2,084.91
Design	236.16	55.20	....	44.82	35.17	1.86	....
Subdivision	74.22	6.50	....	9.29	11.35	1.86	....
Rights and property	22.50	26.30	....	....	....	....	....
Administration	6,915.22	1,080.29	48.47	522.99	524.86	370.65	358.35

PROPOSED LAKE BASIN PROJECT.[a]

The lands that it was proposed to irrigate under this project lie principally in Yellowstone and Sweetgrass counties, Montana. They are situated between Billings and Livingston and run northerly from Yellowstone River about 40 miles to Musselshell River. In this area are two large tracts without natural drainage—Lake basin in T. 2 N., R. 21 E., and Antelope basin in T. 3 N., R. 24 E.

The lowest point in Lake basin has an elevation of 3,903 feet and the lowest pass through the ridge separating Lake basin from Canyon Creek has an elevation of 3,927 feet. The bottom land of this basin is so heavily charged with alkali as to be unfit for agricultural purposes in its present condition, although the alkali might perhaps be washed out by an efficient system of drainage. The land sloping up from this bottom is somewhat rolling, but is good and lies fairly well for irrigation.

Antelope (or Twentymile) basin has an extremely flat bottom, the altitude of its lowest point being about 3,716 feet. There are probably 20,000 acres lying below an elevation of 3,725 feet. The lowest point on the rim surrounding this basin, so far as determined by surveys, has an elevation of 3,788 feet. The lands in the bottom of this basin also contain a large quantity of alkali, but the lands sloping up from the bottom are good and lie better for irrigation than those in the Lake basin, being less broken.

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[a] See also Second Ann. Rept. Reclamation Service, p. 352, and Fourth Ann. Rept. Reclamation Service, p. 228, Pl. XXXIII.

Hoskins basin lies in part in T. 3 N., R. 26 E., at an elevation of less than 3,500 feet on the head of Crooked Creek, which drains the area.

There are also lands on Bitter and Alkali creeks south of Hoskins basin ón the southerly slope of the Sweetgrass divide, and also on Painted Robe, Big Coulee, Fish Creek, and the Musselshell River north of Lake basin. A considerable part of the Painted Robe and Big Coulee valleys are bordered by vertical rim rocks around which it would be impracticable to build a canal, and, therefore, the only way in which the greater part of the lands in these valleys could be irrigated would be to deliver water at the heads of these creeks. This would necessitate a canal over the Sweetgrass divide at an elevation of about 4,900 feet. Such a canal from Yellowstone River would be probably 200 miles long from the point of crossing the Sweetgrass divide to the point of diversion, which would likely be at or above Yankee Jim Canyon, 40 or 50 miles above Livingston.

Such a canal would be in very rough country for a considerable distance around the Crazy Mountains. Measurements of Yellowstone River at Livingston, Mont., show that there is always 2,000 second-feet of water flowing in the river from May to September, although in September there is but little surplus.

The Livingston Land and Irrigation Company diverts, in the canyon above Livingston, water for irrigating about 3,000 acres, and the Livingston Power Company diverts above the town about 250 second-feet. There are numerous irrigation ditches, including those of the Huntley project, and of the Lower Yellowstone project along the entire length of Yellowstone River as well as some power plants, and it is possible that the diversion of 2,000 second-feet at Livingston would interfere with these rights, although the river has some good sized tributaries as well as many smaller ones.

A gaging station has been maintained on Musselshell River near Shawmut, Mont., since August, 1902, but only a few discharge measurements have been taken and no rating table worked up; the inhabitants state that its flow is, however, practically all used now in the irrigating season.

In the Crazy Mountains are the headwaters of several creeks that are tributary to Musselshell and Yellowstone rivers. The more important are Shields River, with a drainage area of about 900 square miles, Sweetgrass Creek, with a drainage area of about 290 square miles, and Big Timber Creek with a drainage area of about 100 square miles. Most of the water from these creeks is used for irrigation in the latter part of the season, but there are said to be considerable floods in the spring.

Notice of appropriation for this project of 2,500 second-feet was posted on the left bank of the Yellowstone near Brisben in section 2, T. 4 S., R. 9 E., Montana principal meridian, on November 28, 1905. Also on the same date notice of appropriation of the same quantity was posted on the left bank of the Yellowstone, near Livingston, in section 7 or 18, T. 2 S., R. 10 E. The above are recorded in Book Miscellaneous, page 35, Park County.

There is said to be a favorable site for a dam near the outlet of Yellowstone Lake. As this lake has an area of about 88,000 acres, extensive storage could be developed if the dam site is as good as supposed.

"Big Lake" is a natural reservoir at which no dam would be required for storage to a 20-foot depth, but there is comparatively little land that could be watered from it. The Hailstone basin has an outlet at an elevation of 3,955 feet. As the bed of the "Big Lake" has an elevation of 3,903 feet, only the poorer lands in the lower part of the basin could be watered from this reservoir unless a long high dam were built.

There is a small basin near Molts Ranch in which about 30,000 acre-feet could be stored if a dam 100 feet high were built. The outlet of this basin is at an elevation of 4,030 feet. The water could be used in the lake basin.

It is possible that some storage could be found in the upper part of the lake basin, but a careful topographical survey would be necessary to develop it.

It would be possible to run water into the Antelope basin, which is very flat. Twenty thousand acres would be covered with a small depth at the lowest point. No dam would be required (up to a depth of 72 feet) but an outlet tunnel about 2 miles long would be necessary to get the water into Hoskins basin where it could be used.

Sand Creek reservoir site (elevation of outlet, 3,743 feet), near the ridge separating the Antelope basin from the Painted Robe drainage, would store about 17,000 acre-feet with a dam about 60 feet high. Water stored in this reservoir could be used in the Antelope basin.

Horse Camp reservoir site, partly in sections 24 and 25, T. 5 N., R. 23 E., has a capacity of about 28,000 acre-feet with a dam 80 feet high. However, this reservoir lies at too great an elevation (top contour 3,960 feet) to be filled from the canal by gravity.

Little Hay basin, in Ts. 4 and 5 N., Rs. 24 and 25 E., is a large basin in which approximately 500,000 acre-feet of water could be stored without any dam, but this reservoir also lies too high (elevation of top contour 3,925 feet) to be filled from the canal by gravity.

About 15 miles above Melville a storage reservoir could be formed on Sweetgrass Creek by building a dam about 100 feet high. About 18,000 acre-feet could be stored if the stream carries water enough to fill the reservoir.

There are several reservoir sites on the headwaters of Musselshell River and its tributaries. Of these only three are so situated that their waters can be diverted into the Lake basin without exceedingly long and expensive canal lines. They drain into the South Fork of the Musselshell, from which it may be practicable to divert by a canal line leading to the Lake basin region. The canals would undoubtedly be very expensive, and the amount of water to be diverted would be comparatively very small.

The field work during the season of 1905 was made with a view of obtaining the entire water supply from Yellowstone River, with the exception of such cross drainage from the Crazy Mountains as would be encountered by the canal line.

It does not appear probable that a sufficient water supply could be obtained from any other source. The flow of the Musselshell River and its tributaries is now practically all used during the latter part of the season for irrigating lands adjacent to these streams, and the same condition exists on Sweetgrass Creek.

A rough classification was made of such lands as would come under a canal located approximately on the traverse lines run out; but a considerable area outside of this, especially on the Musselshell drainage, was included. Traverse lines were run to develop approximate length and locations of canal lines; levels on these lines were carried by the transit, vertical angles being used where necessary.

From a point in the Lake basin at an elevation of 4,213 feet a line rising one foot per mile was run around the end of the Sweetgrass divide and up its southern side until it ran out in Yellowstone River at Livingston, at an elevation of about 4,430 feet. From the same point a line falling one foot per mile was run in the other direction around the western end of the Lake basin, across the divide into and around the Antelope basin, across the divide from that basin to Crooked Creek, and around Hoskins Basin to near the 20-mile station on the Billings and Lewiston stage road, at an elevation of about 3,365 feet. Another line was run from near Busteed in the Lake basin across the Sweetgrass divide and westerly along the southerly side of that slope, at an elevation of about 200 feet above the other line. This line had been carried to a point about opposite Big Timber (elevation 4,530 feet) at the end of November, when the weather became too bad for field work. From Columbus a line of levels was run up Keyser Creek, across Lake and Antelope basins to Antelope station, a distance of about 50 miles. Checks were made at several places on this line to traverse lines. The traverse lines up the southerly slope of the Sweetgrass divide were checked at various points on the Northern Pacific track. No check was made on the traverse line east of Antelope.

Two traverse lines were run from Big Lake to Canyon Creek to investigate the practicability of draining Lake basin. Drainage of the Antelope basin was also investigated by running levels from it to Painted Robe, Crooked, and Bitter creeks.

The Hailstone basin, a basin near Holts ranch, Sand Creek basin, and Little Hay basin, as well as two smaller basins, and a reservoir site on Sweetgrass Creek were investigated for storage reservoirs. These various minor lines aggregate about 85 miles of levels or traverse.

The project allows any one of several methods of development, differing principally in the extent of area to be consider
these are as follows:

(1) Irrigate the whole area of the Lake, Antelo
basins, and also all available lands on the Mussel
stone drainage. If this plan is adopted, it will be
a canal of 4,000 second-feet capacity and over
about one-half of which would be on steep
efficient drainage system must be built for the
basins; besides which, in all probability, prov

for storage on Yellowstone River. The drainage of the Big Lake (lowest part of the Lake basin) could be accomplished by a ditch leading to Canyon Creek. With a maximum cut of about 30 feet this ditch would be 6 or 7 miles long; with one-half mile of tunnel it would be only 3 or 4 miles long. The drainage of the Antelope basin could be most easily effected by cutting through the rim into the head of Crooked Creek. This would require a tunnel about 2½ miles long, with an approach in open cut of about 3 miles more.

This drainage tunnel would, however, be also used to supply irrigation water to Hoskins basin, this water having been turned down into the former basin from the main canal.

(2) Irrigate only a portion of the area, taking the lands near the diversion, so that the canal will have a capacity at its headworks of say 2,000 or 2,500 second-feet. This would probably take the land on the Yellowstone slope of the Sweetgrass divide west of Merrill and a considerable part of the first-class land in the Lake basin.

(3) Irrigate Hoskins basin by storage in the Antelope basin; irrigate some of the higher lands in the Antelope basin, as well as some land along Painted Robe and Big Coulee creeks directly from the canal; store water in the Molt reservoir to the extent of its capacity for irrigation in the Lake basin, and water a large part of the balance of first-class lands in the Lake basin directly from the canal; irrigate directly from the canal the lands along the Yellowstone slope west of Merrill.

The third method has seemed more practicable than others and has been taken as a basis for estimate. Water for storage in Antelope basin would be delivered by the canal into the head of Comanche Creek, down which it would flow into the basin. The water would be carried from Antelope basin to the head of Crooked Creek through a tunnel about 2½ miles long. Water for irrigating on Painted Robe and Big Coulee creeks would be delivered into a branch of Painted Robe Creek and taken out again lower down. The duty of water has been taken as 100 acres per second-foot at the head of the laterals, with an allowance for seepage and evaporation of one-half per cent per mile in the main canal after entering the Lake basin and in the Hoskins basin line. No provision is made for draining Big Lake, and it is not intended to water the alkaline lands adjacent to it, but to leave them as a basin to drain the higher land.

Storage on Sweetgrass Creek would be utilized to supply compensation for loss by seepage and evaporation from the main canal. It is assumed that intercepted cross drainage to Yellowstone River will compensate for the seepage and evaporation from the main canal down to the Lake basin.

A canal from a point on Yellowstone River to the head of Comanche Creek has been located on the map. This canal would run along the southern slope of the Sweetgrass divide to near Patton ranch, at which point a tunnel 4 miles long would carry the water through the divide to a point in the Lake basin near Busteed. The canal would then run around the edge of Hailstone and Lake basins to the head of Comanche Creek. A second canal, or rather a continuation of the above, has been projected. This canal would start from the Antelope basin reservoir site and would run around Hoskins basin.

As the area was not mapped in detail, and as the projected canals do not closely follow the traverse lines, the location is of the roughest kind, but is believed to be accurate enough for the purposes of an estimate.

On a part of the length of the canal the material has been taken as class 2 (loose rock, etc.), which showed on the surface, while it is not improbable that the material in the lower part of the excavation would be class 3 (solid rock). Aggregate lengths of various classes of sections, excepting natural stream beds, are as follows: Twenty-four miles, tunnels; 67 miles, concrete-lined sections, and 111 miles earth canal (unlined).

The lateral system will require a number of miles of large-sized canal around the north and south sides of the Lake basin, and from the end of the projected line to Painted Robe Creek.

On a basis of 200,000 acres the estimated cost would be over $100 per acre.

The expenditures on the proposed Lake basin project are summarized in the following table:

Expenditures, according to purpose and nature, on proposed Lake Basin project to June 30, 1906.

[Total, $7,015.46.]

	Services.	Traveling.	Subsistence.	Equipment.	Supplies.	Rent and storage.	Forage.
Engineering:							
Examination	$4,463.79	$608.39	$794.28	$152.29	$196.90	$133.33	$394.81
Rights and property	5.50						
Administration	166.67	73.80			25.70		

PROPOSED CLARKE FORK PROJECT.

In compliance with request in May, 1905, from a delegation representing the Clarke Fork Canyon Water Users' Association and residents in the vicinity of Clarke Fork, Mont., an investigation was undertaken to determine the feasibility of developing an irrigation project under the reclamation act in the vicinity of Clarke Fork, Carbon County, Mont. The work included the mapping and classification of the irrigable lands in order to obtain an approximate estimate of the cost of irrigation works.

The basin of the river above the proposed diversion includes the high mountains lying east of the Yellowstone National Park. It has an elevation of 10,000 to 12,000 feet, and an area of 1,000 square miles. It is entirely within the Yellowstone Forest Reserve, and, as it is heavily timbered, the snow remains until late in the summer, affording an abundant supply of water throughout the year.

A gaging station was established in June, 1905, at Fromberg, a point practically below all of the private canals taking water from the fork. A discharge measurement made by Mr. W. P. Wood, chief engineer of the Yellowstone Park Railway, on November 10, at a point 10 miles above the proposed diversion showed a flow of 254 second-feet. The above low-water measurement and the records at the gaging station show that sufficient water is available for all the land under the project.

The head of the proposed canal (Pl. XLV) is near the lower end of Clarke Fork Canyon in Wyoming, and about 15 miles from the Wyoming-Montana line. A large tract immediately below the point of diversion, aggregating about 20,000 acres of land, lies well for distribution of water, but is not available for cultivation, as the soil is almost entirely a cemented gravel and is full of boulders. This area is not included in the estimate. There are approximately 60,000 acres of land that can be reclaimed under the canal as located. Of this 30,000 acres are first class; the balance, owing to poor quality of soil and the irregularity of its surface, due to the numerous ravines by which it is crossed, is not very attractive. It is very questionable whether the third-class land would be in demand at any price.

Along Clarke Fork, Rocky Fork, and Red Lodge Creek are the low valley lands common to most rivers. These lands are generally 10 to 30 feet above these streams and are already irrigated. In the area under this project there are probably 40,000 acres of land under cultivation and 10,000 acres that are too poor for farming and are used for pasturage.

To the west of this irrigated strip, on Clarke Fork, is an area 400 square miles in extent. This whole district is very rugged, numerous hills rising to heights from 500 to 1,000 feet above the valleys. The valleys are long and narrow with occasional patches of good soil, varying in size from 100 to 1,000 acres. Between these valleys is a large area of worthless lands, ranging from poor grazing land to bad lands, and comprising three-quarters of the total area of the proposed project. So scattered are the irrigable lands that, in addition to the main canal, several canals of small capacity but of considerable length will be necessary. The distribution of the lands is shown in the following table:

Classification of irrigable lands.

	First class.	Second class.	Third class.	Total.
	Acres.	*Acres.*	*Acres.*	*Acres.*
Bennett Creek	2,700	820	550	4,070
Dillworth and Grove creeks	6,395	2,005	3,085	11,485
Dry Creek	6,365	2,310	6,025	14,700
Elbow Creek	3,760	1,560	1,890	7,210
Bear and Wolf creeks	....	1,780	800	2,580
Joliet and vicinity	3,645	2,170	3,800	9,615
Cole Creek	1,200	350	840	2,390
White Horse Bench	5,180	850	1,360	7,390
Total	29,243	11,845	18,350	59,440

The point of diversion was selected at a place where the canyon narrows considerably and where there are rock abutments. Bed rock is presumably near the surface, as rock outcrops on both sides of the stream. A dam with its crest 25 feet above the bed of the stream was proposed as being cheaper than the difficult canyon work necessary for a diversion at the water level. From this diversion point the water would be taken in canal to the Elbow Creek drainage, a distance of 56 miles. After reaching Elbow Creek the water would be turned into the natural channels wherever possible and the distributing canals used to reach the isolated areas. For the first 5 miles the proposed canal would run through a loose rock formation, and cement lining would be necessary to prevent loss of water. As the canal leaves the canyon a tunnel 660 feet long would be necessary to avoid a precipitous rock cliff. From this point to mile 32 the location is on a sidehill, varying in slope from 10° to 20°. In this division there is one tunnel 1,400 feet in length and a few miles of heavy excavation on a slope as steep as 35°. Between miles 32 and 45 the canal would cross the "bad lands" from the head of Grove Creek to the head of Dry Creek, and some difficult and heavy work is necessary. The "bad lands," consisting of long ridges and steep side hills, composed of numerous sandstone strata, shale, and coal seams, make a very dangerous location for a canal, and it may be found that considerable stretches may require a cement lining. The estimates, however, are based simply on excavating an unlined canal on slopes varying from 15° to 35°. An attempt was made to avoid the three tunnels in this section, but the great length of the line and the steep side slopes would make an open canal more expensive than the tunnels. One tunnel 2,400 feet long is located in the divide between Grove and Wolf creeks, one 8,000 feet long is between Wolf and Bear creeks, and one 2,400 feet long is between Bear and Dry creeks. The tunnels would require lining throughout. The canal from mile 45 to 53 would be on sidehill varying in slope from 10° to 30°, the next 2½ miles would be on a very rough hillside, at the end of which would be a tunnel 3,000 feet long to the Elbow Creek drainage. The last 2½ miles preceding this tunnel would be mostly on a slope averaging 30°, and construction and maintenance would be very expensive. The sidehill is very much broken by drainage channels and deep ravines, and can only be avoided by a tunnel 13,000 feet long heading at the 50½-mile station. This tunnel, from the present data, would be more expensive than the location estimated on, but a survey in detail might prove it to be more economical.

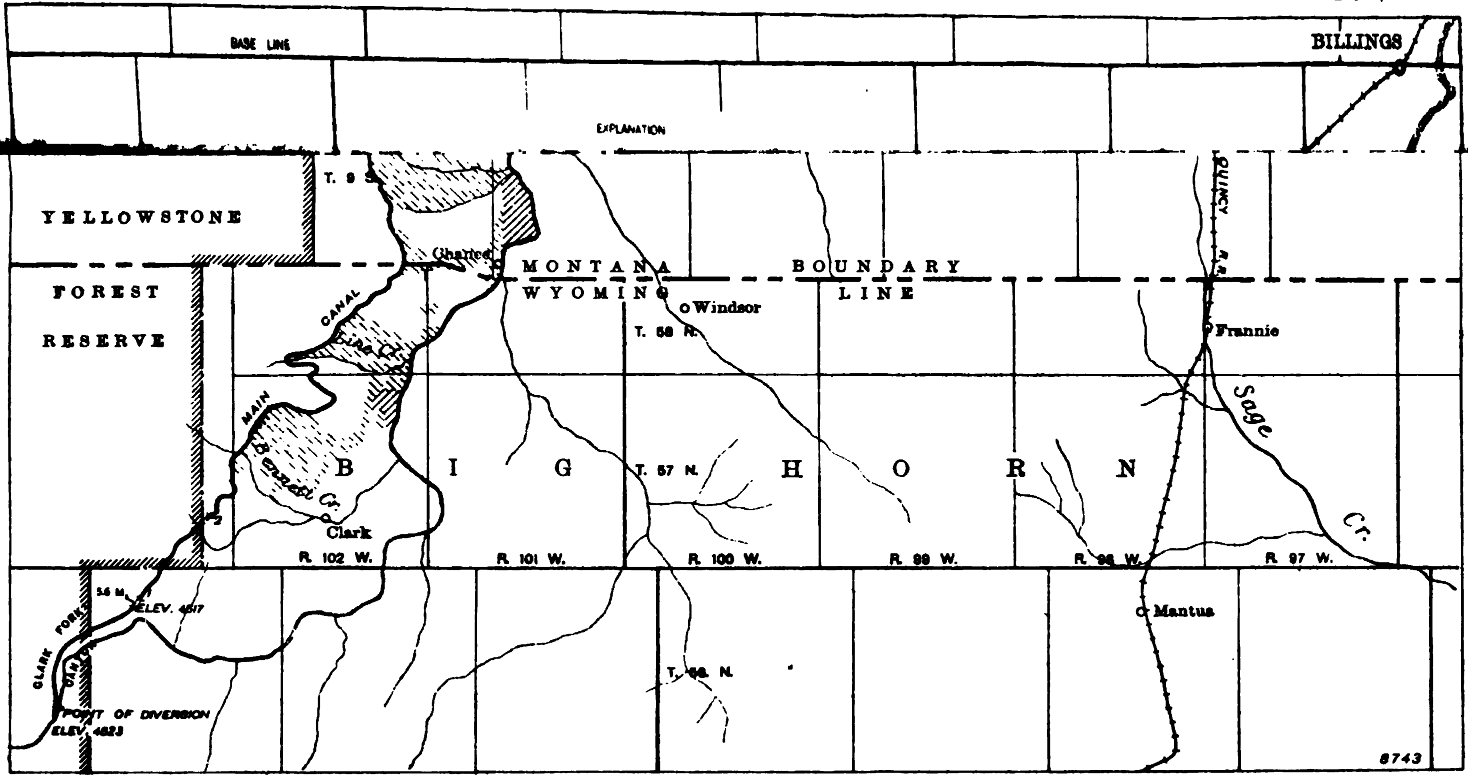
The canal is projected to divert 950 second-feet in the canyon and to discharge 358 second-feet at the end of tunnel No. 6, the difference, less the seepage, having been used in irrigating the land found between these points. Seepage is estimated at a loss of 0.5 per cent per mile. A grade of 1 foot per mile is maintained throughout the line, except in the tunnel sections.

There would be necessary 130 miles of distributing canals, varying in length from 5 to 35 miles. The natural drainage channels would be used wherever possible, but as many of these watercourses are very steep maintenance will be expensive.

The proposed project includes about 60,000 acres of land, of which 30,000 are first class, 12,000 are second class, and 18,000 are third class. The estimates show a cost of approximately $50 per acre, and as the third-class land is, at the present time, not desirable, the total cost might have to be carried by the first and second class land. In this case the cost per acre would be considerably increased. It is probable that the acreage of first-class land may be somewhat reduced, and that the cost of construction may be increased by the final surveys.

It is possible that increased demand for land may, in the future, make this project a feasible one, but for the present the cost is thought to be greater than the land could stand.

In July, 1906, a reconnaissance trip was made, barometric observations were taken, and estimates made of the areas of available land on the right or east side of Clarke Fork in the vicinity of the Montana-Wyoming State line. An area containing approximately 12,000



GENERAL MAP CLARK FORK PROJECT, MONTANA-WYOMING.

acres of bench land was located in T. 56 N., R. 102 W., Wyoming. The soil is apparently good and the land is well located for distributing water, but, owing to its high elevation above Clarke Fork Canyon and the rough country through which the canal would have to be constructed, it is believed that this tract is not feasible of irrigation from the waters of Clarke Fork.

No other sizable tract of irrigable land was found between this bench and the State line. Numerous small areas of irrigable land containing a few hundred acres each, low enough in elevation to be watered from Clarke Fork,were found. One tract of approximately 3,000 acres is located high up on Big Sand Coulee, elevation about 4,400 feet, which could probably be developed at a feasible cost by diverting water from the proposed high-line canal of the Shoshone project in Wyoming, but it is not thought it can be irrigated from Clarke Fork. The tract of land known locally as the "Big Mesa" is in the Shoshone drainage. It is too high to be watered from Clarke Fork.

The expenditures are summarized in the following table:

Expenditures, according to purpose and nature, on proposed Clarke Fork project to June 30, 1906.

[Total, $5,795.06.]

	Services.	Traveling.	Subsistence.	Equipment.	Supplies.	Rent and storage.	Forage.
Engineering:							
Examination	$3,078.97	$397.46	$461.98	$556.07	$218.91	$23.95	$244.78
Survey	21.25	5.65			3.33		
Administration	534.00	172.86			35.85	40.00	

PROPOSED MADISON RIVER PROJECT.[a]

The main part of this proposed project contemplates the irrigation of about 43,000 acres of land in and adjacent to Prickly Pear Valley near Helena, at an elevation of from 3,650 to 3,900 feet above sea level; a second tract of about 53,000 acres in the Crow Creek Valley on the west side of Missouri River near Radersburg, at an elevation of from 3,900 to 4,300 feet, and other smaller areas aggregating about 52,000 acres, a total of 148,000 acres.

In order to accomplish this it will be necessary to build in the Madison River Canyon a dam about 150 feet high and 400 feet long on top, thereby impounding about 600,000 acre-feet of water. This stored water would be discharged into Madison River as required; and at a point about 7 miles below the dam, near the mouth of Cottonwood Gulch, diverted by means of a weir into a canal on the river's west bank. This canal would follow the left bank of Madison River for about 30 miles, would cross Jefferson River in the vicinity of Willow Creek, or Sappington, by a siphon over 3 miles long, and thence would generally run parallel to, but some distance from, the west bank of Missouri River, to a point on McClellan Creek, into which its waters would discharge. For about 2½ miles the natural channels of McClellan and Prickly Pear creeks are used, and diversion is again made from the latter near East Helena, the canal then encircling Prickly Pear Valley, and.discharging into a coulee at its lower end.

Apparently the only practicable plan was to divert water from the

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[a] See Fourth Ann. Rept. Reclamation Service, Pl. XXXIV.

Madison near Cottonwood Gulch, and a party was started early in May, 1905, at Winston Summit (elevation 4,361 feet), then supposed to be the controlling pass, and a fly line of levels was run to the mouth of Cottonwood Gulch, in the general direction of a canal line. These levels showed that there are two higher summits than Winston, namely: Crow Creek divide (elevation 4,519 feet), and Mulligans Gap (elevation 4,634 feet.) A preliminary line was run from Madison River at an elevation of 4,510 feet, near the mouth of Cottonwood Gulch. This line was carried to near Warm Spring Creek, on the northern side of Crow Creek divide, two different crossings of the Jefferson River being examined.

From this point to Prickly Pear Creek the line was continued as a traverse line by azimuths and stadia, the elevations being determined by vertical angles. Seventeen U. S. G. S. permanent bench marks were set.

From the northern end of the siphon line across Jefferson River near Sappington, a plane table traverse was run up Jefferson River to a point about halfway between Jefferson Island and Whitehall, where it was abandoned, owing to the large amount of heavy work already encountered and the length of line still necessary before the canal grade would run out, Jefferson River being much flatter than the Madison.

A traverse line by azimuths and stadia, the elevations being determined by vertical angles, was run from a point on the right bank of the Missouri River about 3 miles above Toston, northerly, on the east side of that river, to Avalanch Gulch.

Several power plants are interested in the water of the Madison River. The Madison River power plant, developing power for electric transmission to Butte, has a dam in sections 19 or 20, T. 4 S., R. 1 E., that stores about 46,000 acre-feet of water in the lower end of the Madison Valley. It is intended to install power plants at intervals through the canyon, the tail water to be eventually discharged a short distance above the mouth of Cottonwood Gulch. The power plant at Canyon Ferry on Missouri River develops about 11,000 horsepower for electric transmission to Helena and Butte; taking the head as 30 feet at this plant, and the efficiency at 80 per cent, about 4,000 second-feet of water are required. Three power plants at Great Falls develop about 12,700 horsepower; allowing here a 42-foot head and 80 per cent efficiency, about 3,325 second-feet of water are required, to which should be added about 45 second-feet used for concentration, making a total of about 3,370 second-feet. Another plant is to be constructed on Missouri River 15 miles, more or less, below Canyon Ferry which will develop 10,000 to 14,000 horsepower and probably use about the same quantity of water as the Canyon Ferry plant.

As the Madison River plant uses about 1,400 second-feet of water, it will be necessary to allow this amount of water for the plant if the irrigation canal heads above the power plant. If the diversion is below the tailrace of the power plant this amount may be used for irrigation; therefore the diversion point for the main canal was located just below the mouth of Cottonwood Gulch.

The Canyon Ferry plant requires about 4,000 second-feet of water to run all of its ten turbines. Missouri River is formed by the junction of Jefferson, Madison, and Gallatin rivers near Three Forks;

therefore, when the flow of the Missouri falls below 4,000 second-feet, which happens at times, any diversion from Madison River would result in a shortage of water at this power plant, and storage must be provided in order to regulate the flow of Missouri River.

It might be possible to raise the dam at Canyon Ferry so that the same amount of the power may be developed by a smaller quantity of water, but even in this case the entire flow of Madison River is not adequate in August and September to supply the water necessary for irrigation. It is also possible that a small part of the water used for irrigation would find its way back into Missouri River above Canyon Ferry; but some of the land below the canal would drain into the river below this point, and no account has been taken of the water which might be returned to the river from this source.

As the plant at Canyon Ferry uses more water than the plant at Great Falls, there would be no trouble at Great Falls if sufficient water is flowing in Missouri River to satisfy the demand at Canyon Ferry.

There are five United States reservoir sites on the drainage area of Jefferson River, described in the Twelfth and Thirteenth Annual Reports of the United States Geological Survey.

On the Bighole River there is a reservoir site in T. 5 S., R. 8 W. With a dam 100 feet high this reservoir at the top contour would have an area of 11,800 acres, and an approximate capacity of 390,000 acre-feet. A part of this reservoir site, at least, is traversed by the Oregon Short Line Railroad, and as the country is mountainous it is probable that the cost of relocating this railroad would be large.

Another reservoir site is located on Blacktail Deer Creek, in T. 9 S., R. 8 W. With a dam 40 feet high, this reservoir will have an area of 600 acres at top contour, and a capacity of approximately 8,000 acre-feet.

A third reservoir site is situated on Beaverhead River, T. 9 S., R. 10 W. With a dam 125 feet in height, the reservoir would have an area of 1,400 acres and a capacity of approximately 58,000 acre-feet. This reservoir site is also traversed by the Oregon Short Line Railroad, and the cost of relocating this railroad would probably be high, as the country is mountainous.

Another reservoir site is situated on Red Rock River in T. 13 S., R. 8 W. With a dam 40 feet high the area inclosed by top contour would be 1,200 acres, and the approximate capacity would be 16,000 acre-feet.

Still another reservoir site is located on Ruby River in T. 7 S., R. 4 W. With dam 35 feet in height the area of this reservoir at the top contour would be 400 acres, and the capacity would be approximately 4,500 acre-feet.

There is a reservoir site on Sixteenmile Creek in T. 6 and 7 N., R. 8 E. This reservoir would have an area of 1,055 acres, and a capacity of 19,800 acre-feet.

Besides these, it is reported to be possible to raise the surface of the Red Rock Lakes by a dam about 20 feet high, and thereby provide a reservoir of about 135,000 acre-feet capacity. These lakes are located in T. 14 S., R. 1 and 2 W. This reservoir is probably to be built by private parties, however, for irrigation of other lands.

Another reservoir on upper Madison River is located in T. 12 S., R. 4 E.

A careful inspection of the maps of the drainage basin of Madison River and a trip along the entire length of the river show that probably the most feasible reservoir site for the storage of a large quantity of water is in the lower end of the Madison Valley, so-called.

A dam near the present power plant, about 100 feet higher than the flashboards of the present dam, or about 145 feet above the river bed, would flood about 14,500 acres, and from such rough estimate as can be made from the survey of the top contour, would give a storage capacity of approximately 600,000 acre-feet. A portion of this land is now flooded by the power plant's reservoir, which has a capacity of about 46,000 acre-feet; the balance is nearly all in private ownership, considerable portions of which are cultivated, and it is probable that this land could not be acquired by the Government for less than $20 per acre.

It is possible that a small reservoir could be built on the headwaters of Crow Creek and the water so stored taken into the canal near Radersburg.

It may be possible to store about 60,000 acre-feet of water in Cherry Creek basin, T. 4 S., R. 3 E., by a dam 100 feet high and about 650 feet long, provided the run-off of the drainage area is sufficient. Cherry Creek is, however, tributary to the Madison at a point below the diversion of the main line, and so far as that line is concerned, would be useful only as compensation water for the power plants on Missouri River.

Any of the reservoir sites on the drainage area of Jefferson River would likewise only be useful for storing water to compensate the power plants on the Missouri for the water diverted from the Madison, and, as before stated, since the entire flow of the Madison at low water is insufficient for the proposed main canal, only the reservoirs on Madison River have been considered in connection with that line.

Gaging stations have been maintained on the Upper Missouri River and its tributaries, as follows:

Missouri River at Townsend, Oct. 1, 1891, to May 31, 1904.
Missouri River at Cascade, since July 20, 1902.
Madison River at Three Forks, August 24, 1893, to May 2, 1897.
Madison River (including Cherry Creek), near Red Bluff, April 4, 1890, to November 30, 1894, and May 2, 1897, to December 31, 1905.
Gallatin River at Logan, since 1893.
Jefferson River near Sappington, since November, 1894, to December 31, 1905.

From 1897 to 1900 there was a series of years of large flow, during which the reservoir would fill and always have water in it, but since 1901 there has been a series of "dry" years, which would have emptied the reservoir in 1903 and 1904, and again in 1905.

The capacity of 600,000 acre-feet is from a very rough estimate and is probably small; also, it would be possible to build the dam higher and thereby increase the storage to the limit of the water supply, but this would mean going to a considerable expense to prevent a small shortage of water, say, once in ten years.

There are several comparatively small private ditches taking water from Madison and Missouri rivers, the most important being three, known as the Montana, Yankee, and Irish ditches, near Townsend. Data are not available to show the quantity of water thus diverted.

Notices of appropriation were posted, as follows:

On May 20, 1905, for 2,000 second-feet on the left bank of the Madison, near the mouth of Cottonwood Gulch.

On May 20, 1905, for 500 second-feet on the right bank of the Madison, about 2 miles above the mouth of Hot Springs Creek.

On May 19, 1905, for 500 second-feet on the right bank of Missouri River, about 3 miles above Toston.

The irrigable land has been divided into three classes:

Class 1, good light soil of a uniform character, nearly free from stone and gravel and showing no alkali on the surface, also the good black soil found in the bottoms, likewise free from the above-mentioned defects.

Class 2, light bench and dark bottom soil containing some stone, gravel, or alkali.

Class 3, soil that contains a great deal of gravel and stone, but is still cultivable. This third-class land has not been considered worthy of irrigation, owing to the extra quantity of water, necessarily entailing increase in size of canal as well as storage.

The lands in the Jefferson and Madison River bottoms, mostly second class, have been left out, as they can probably be watered by small ditches from those rivers and Willow Creek.

There are 119,670 acres of irrigable land of Class 1 lying under the canal and 25,470 acres of Class 2, a total of 145,140 acres. The cultivated lands in the Prickly Pear Valley have an area of 7,985 acres. This latter land is, however, insufficiently watered from Prickly Pear Creek and its tributaries; consequently it has been assumed that there is water sufficient for two-thirds of the area and that water should be provided from the canal for the remaining one-third, or 2,660 acres, making a grand total of 147,800 acres.

Two thousand second-feet have been assumed as the quantity to be diverted from Madison River. It was assumed that there would be a loss of one-half of 1 per cent per mile by seepage and evaporation in earth sections, and no loss in lined and tunnel sections. The amount of seepage was thus found to be about 440 second-feet, which allows 1,560 second-feet at the heads of the laterals.

If the irrigable land amounts to 148,000 acres and the water supply is 1,560 second-feet, there would be one second-foot available for 95 acres. As a flow of 1,560 second-feet is equivalent to 3,120 acre-feet per day, there would be available during an irrigation season of one hundred and twenty days 374,400 acre-feet, or enough water to cover 148,000 acres to a depth of 2.5 feet.

In the Prickly Pear Valley the principal crops, at present, are alfalfa, oats, and potatoes. Five tons of alfalfa are considered a large crop for three cuttings. Oats are said to yield 60 bushels per acre. In the bottom watered from Willow Creek considerable quantities of alfalfa are raised.

The surveys show that besides the dam in Madison River there would be necessary 16 miles of tunnel, 4 miles of siphon pressure pipe, 27¾ miles of concrete-lined canal, 99½ miles of earth canal (unlined), one drop of 70 feet and a drop of 260 feet.

On a basis of 150,000 acres, the preliminary estimate gives a cost per acre of approximately $100, exclusive of the cost of the dam site.

A small independent part of the project contemplates the irrigation of an area on the east bank of Missouri River in the vicinity of

Toston and Townsend. Water would be diverted from Missouri River about 3½ miles above Toston.

A classification of the irrigable land shows a total of 9,180 acres class 1, and 2,490 acres class 2, or a total of 11,670 acres. There are, however, considerable areas of good agricultural land lying above the line. There are 5,140 acres of cultivated land below the projected canal line irrigated from Dry, Greyson, Deep, Gurnet, and Duck creeks and Confederate Gulch. If satisfactory arrangements could be made with the owners of these water rights, as now seems probable, their lands could be watered from the canal and the water from the creeks used on land above the canal. Therefore, this area of 5,140 acres, now watered from these creeks, has been included with the irrigable lands, making a total of 16,800 acres.

There are probably about 3,000 acres north of Confederate Gulch that could be irrigated by extending this canal to Avalanch Gulch, but this involves about 20 miles additional line besides an increased canal section in the 30 miles from the headworks to Confederate Gulch, therefore, no land beyond this point has been considered. Most of the land under this canal is in private or State ownership and no withdrawals from entry have been made.

The crops at present raised in the Townsend Valley are principally alfalfa, oats, wheat, and some rye.

If one second-foot of water is required for 100 acres, 168 second-feet would be needed at the head of the laterals; adding 10 per cent to this to cover losses from seepage and evaporation, a diversion of 185 second-feet is necessary.

The discharge measurements of Missouri River show that the minimum flow is always below 4,000 second-feet in August and September, and frequently in July, and it will, therefore, be necessary to store all water for use during these periods.

The expenditures are summarized in the following table:

Expenditures, according to purpose and nature on proposed Madison River project to June 30, 1906.

[Total, $10,546.96.]

	Services.	Traveling.	Subsistence.	Equipment.	Supplies.	Rent and storage.	Forage.
Engineering:							
Examination	$6,711.38	$730.91	$1,159.48	$204.29	$293.34	$130.84	$515.59
Survey		76.80		55.25	1.00		
Rights and property					6.00		
Administration	494.83	116.72		17.78	6.25	17.50	

PROPOSED CROW RESERVATION PROJECT.

GENERAL DESCRIPTION.

The lands under this proposed project are mostly within the ceded strip of the Crow Indian Reservation. The feasible irrigation projects developed by the surveys made are naturally separated into several subprojects, each more or less complete in itself. These subprojects have been outlined and a general map published in the Fourth Annual Report, pages 225 to 228.

The act of April 27, 1904, provides that all the lands included in the ceded portion of the Crow Reservation except those withdrawn for the Huntley project should be opened for settlement on July 16, 1906. As private capital will probably undertake the development of this area, a summary of the Government surveys will be given.

FORT CUSTER DIVISION.

The Fort Custer canal was surveyed and a preliminary location projected. The irrigable lands under this canal amount to about 28,000 acres, of which about 8,000 acres are included in the old Fort Custer Military Reservation. The estimates assumed that the Indian Department would pay a portion of the cost or authorize the leasing of the lands in the diminished reservation. The plans on which the estimates were based included a diversion weir across Bighorn River above the mouth of Two Leggin Creek. This was included because the irrigation work planned in Wyoming will eventually reduce the low-water flow of the river to a point where a temporary headworks at the given elevation would not suffice.

It was planned to divert 405 cubic feet of water per second in a canal 25 feet wide on the bottom, with side slopes of 1½ to 1 and a depth to top of bank of 7.6 feet. This would provide a normal flow 5.1 feet deep, with a velocity of 2½ feet per second. The canal as surveyed was 43 miles long. Its size would be reduced toward the end.

WACO-SANDERS DIVISION.

Surveys were made and an investigation conducted looking toward the irrigation of the largest possible acreage south of Yellowstone River below Waco. Under the Waco ditch about 4,500 acres of fine land can be developed by a comparatively inexpensive canal system. The development of power was also considered. It is doubtful if it is feasible to pump water for irrigation, but the power developed could probably be used for commercial purposes.

About 13,000 acres in the Sanders tract can be developed by a low-line canal taking water from Yellowstone River near Meyers station on the Northern Pacific Railway. Surveys were made for a high-line canal to irrigate the Sanders tract and about 1,500 acres at the mouth of the Bighorn, but this is not a feasible undertaking owing to the expensive construction along Guy's bluffs above Meyers station.

BIGHORN DIVISION.

A survey has been made of a canal line from a proposed dam at the mouth of Bighorn canyon to Toluca on the Chicago, Burlington and Quincy Railway, with a branch to the bench lands near Peritsa station. The line that was considered most feasible would cross Two Leggin Creek by means of a siphon and thence would run along the bench above the Fort Custer canal until a junction with the Peritsa lateral was effected. About 44,000 acres would be irrigated from this canal.

A large portion of the lands under what was called the Bighorn high-line canal are inside the limits of the Crow Reservation, and for this reason, as well as the high cost per acre, it is probable that nothing will be done to develop this project.

EXPENDITURES.

The expenditures on the proposed Crow Reservation project are summarized in the following table:

Expenditures, according to purpose and nature, on proposed Crow Reservation project to June 30, 1906.

[Total, $21,032.58.]

	Services.	Traveling.	Subsistence.	Equipment.	Materials.	Supplies.	Rent and storage.	Forage.
Engineering:								
Examination	$7,695.62	$1,501.16	$2,138.99	$1,223.12	....	$1,121.52	$6.02	$432.32
Survey	2,609.40	463.59	24.51	82.06	$2.03	25.59	1.50	161.10
Design	1,291.92	....	....	....	....	....	....	....
Subdivision	214.33	....	24.36	....	....	....	....	....
Administration	1,267.73	102.16	239.18	144.90	....	143.55	67.00	48.92

NEBRASKA-WYOMING.

NORTH PLATTE PROJECT.

GENERAL STATEMENT.

The main features of the North Platte project are summarized below:

Summary of principal data relating to North Platte project.

Counties: Natrona, Carbon, Converse, Laramie, Wyo.; Sioux, Scottsbluff, Banner, Cheyenne, Nebr.
Latitude: 41° 30′.
Longitude: 102°.
Townships: 20 to 26 north, range 48 to 66 west.
Average rainfall: 9 to 18 inches.
Range of temperature: Maximum, 100°; minimum, −20°; mean, 45°.
Average elevation: 3,800 to 4,200 feet.
Principal products: Alfalfa, cereals, corn, sugar beets, potatoes.
Nearest railroad: Burlington and Missouri River Railroad traverses project. The Union Pacific will probably build along west side of North Platte and Laramie rivers.
Nearest stations: Northport, Bridgeport, Bayard, Minatare, Scottsbluff, Mitchell, Morrill, Pratt, Torrington.
Principal markets: Denver, Omaha, central Wyoming.
Proportion of public land: 65 per cent.
Character of soil: Sandy loam.
Value of irrigated land: $40 to $75 per acre.
Completion of project: First 50 miles of Interstate canal in operation June, 1906. Building of second 50 miles well under way and should be completed during season of 1907.
Watershed area: About 12,000 square miles above reservoir.
Estimated run-off: About 3,000,000 acre-feet per annum.
Reservoir area: About 21,000 acres.
Capacity of reservoir: 1,000,000 acre-feet.
Duty of water: 100 acres per 1½ second-feet; 2 acre-feet per annum over land.
Length of dam: On crest about 500 feet.
Dam type: Arched masonry.
Reservoir dam height: 215 feet.
Headgates and diversion dam: Reinforced concrete.
Diversion dam length: About 325 feet.
Length of canals: About 450 miles.
Length of laterals: About 500 miles.

The North Platte project at present contemplates the building of two principal works—the Pathfinder dam and reservoir and the Interstate canal. The Pathfinder reservoir will be formed by building a masonry dam of the arch type across North Platte River in central Wyoming. The reservoir will be of sufficient capacity to store water during the flood season for distribution to the various canals along the river during times of the river's diminished flow. The Interstate canal has been selected as being the most promising of the various canal subprojects for immediate returns under the irrigation system. The land to be irrigated lies on the north side of North Platte River between Whalen, Wyo., and Bridgeport, Nebr.

In order to facilitate the transportation of materials and supplies to the Pathfinder dam, it was necessary for the Government to build a pile bridge across North Platte River near Casper, Wyo. This bridge was completed in October, 1905, and has been in use since that time. The proper administration and supervision of the work has also required the erection of cottages, warehouses, and other buildings at Wyncote, Wyo., at Mitchell, Nebr., and at the dam site in Wyoming.

In the following table are listed the contracts entered into for building work on the North Platte project. This list includes all contracts for excavation, embankment, masonry, and erection of structures, but does not include materials such as cement, steel, timber, etc.

Contracts for building work on North Platte project to June 30, 1906.

No. of contract.	Contractor.	Feature.	Estimated total value.[a]	Payments to June 30, 1906.	Per cent paid.
28	Kilpatrick Bros. & Collins.	Pathfinder tunnel	$34,292.00	$33,259.75	100
39	Robinson & Maney	Interstate canal, first contract, divisions 1, 2, 6, 9, 10.	[b] 261,809.00	303,167.96	100
40	Griffiths & McDermott	Interstate canal, first contract, division 3.	78,135.00	64,446.64	100
41	Deadwood Construction Co.	Interstate canal, first contract, division 4.	32,695.00	47,679.04	100
42	Orman & Crook	Interstate canal, first contract, division 5.	[b] 81,036.00	78,497.15	100
43	James O'Connor	Interstate canal, first contract, division 8.	[b] 42,152.00	50,606.52	100
61	Jas. F. Stanley	Bridge	3,385.00	3,114.98	100
63	Geddis & Seerie	Pathfinder dam	482,000.00	23,493.82	5
74	W. O. Morrison	Structures	130,876.90	42,957.67	33
75	Burke Construction Co	Interstate canal, second contract, division 7.	76,240.00	8,537.60	11
76	James O'Connor	Interstate canal, second contract, division 6.	77,360.00	20,529.12	27
83	Deadwood Construction Co.	Interstate canal, second contract, divisions 1-5, 8.	309,351.00	38,375.76	12

[a] For a discussion of advance estimates and final costs, see page 51.
[b] Original estimated value revised upon supplemental contract providing for earlier completion.

PATHFINDER DAM AND RESERVOIR.[a]

The Pathfinder dam is located in a granite canyon on North Platte River, about 3 miles below the junction with Sweetwater River and about 45 miles southwest of Casper, Wyo. At this point the canyon varies in width from 80 to 180 feet, and affords an ideal site for a dam. The dimensions of the dam are shown in the following table:

Dimensions of Pathfinder dam.

Elevation spillway above sea level	feet	5,850
Elevation top of dam above sea level	do	5,860
Total height of dam from lowest point of foundation to top of parapet	do	215
Thickness of dam at top	do	16
Thickness of dam at bottom, approximately	do	100
Length of dam, approximately	do	390
Radius of arch	do	150
Batter of upstream face	per cent	15
Batter of downstream face	do	25
Approximate amount of masonry in structure	cubic yards	55,000

The main body of the dam is to be of cyclopean rubble, the greater part of the stone used being obtained from the spillway excavation. A spillway about 600 feet in length, designed for a discharge capacity of approximately 43,000 second-feet, will be constructed at the north end of the dam. This spillway, with the exception of a portion about 150 feet in length, will be excavated in solid rock.

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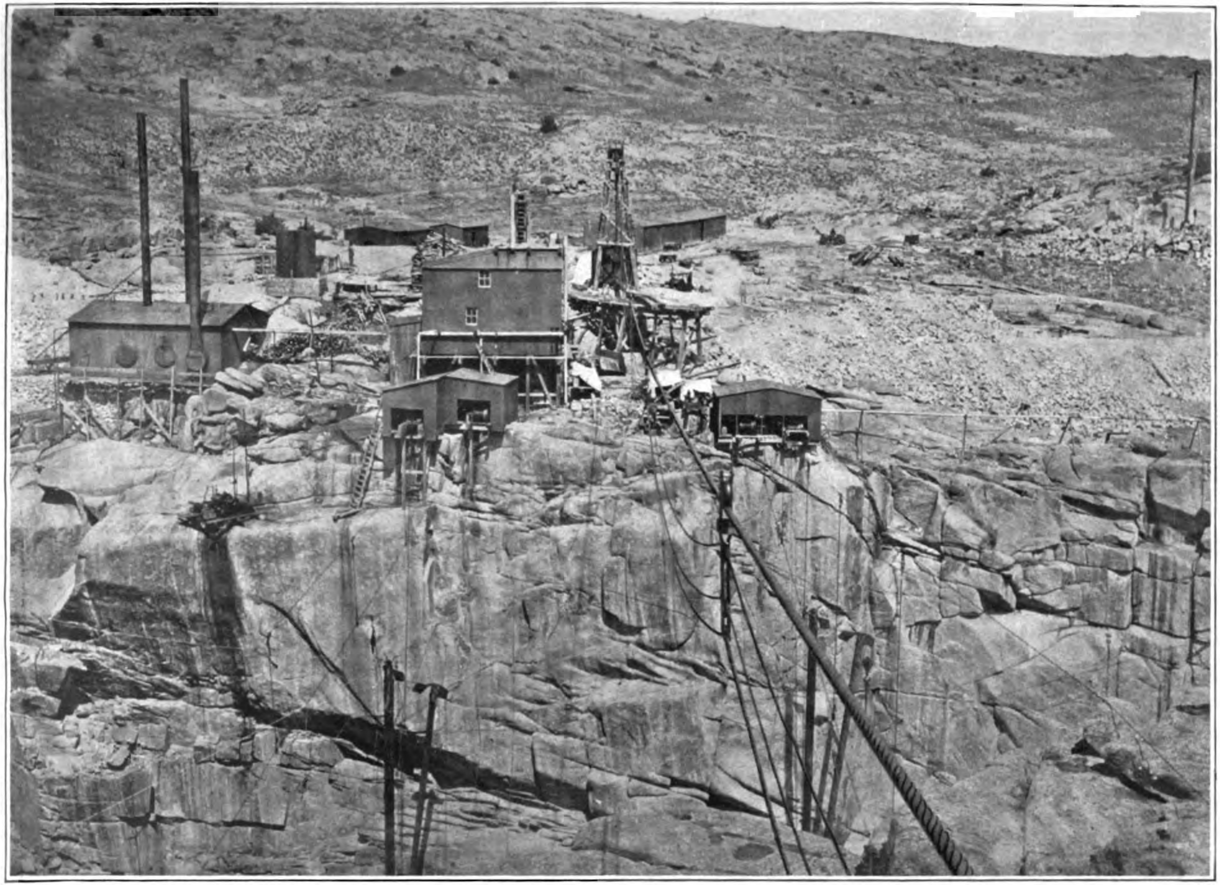
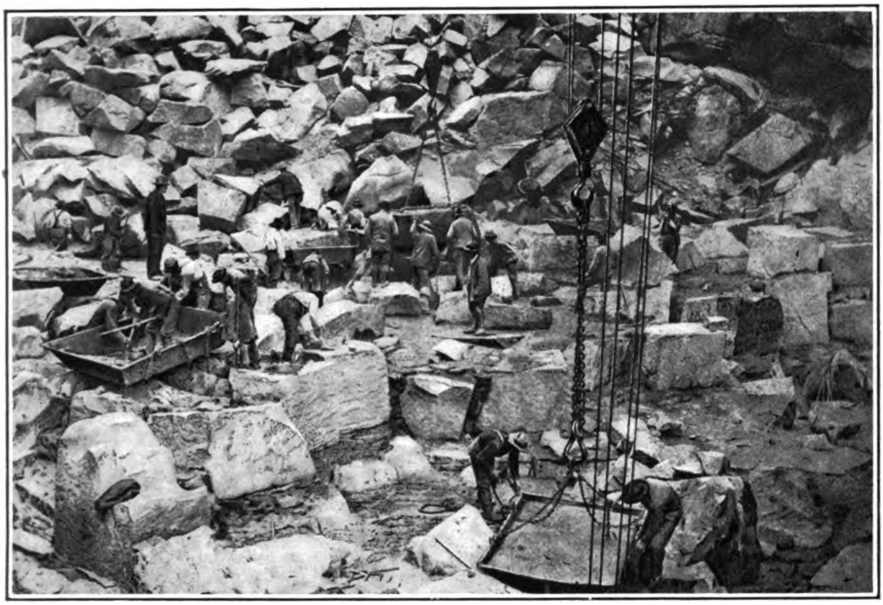
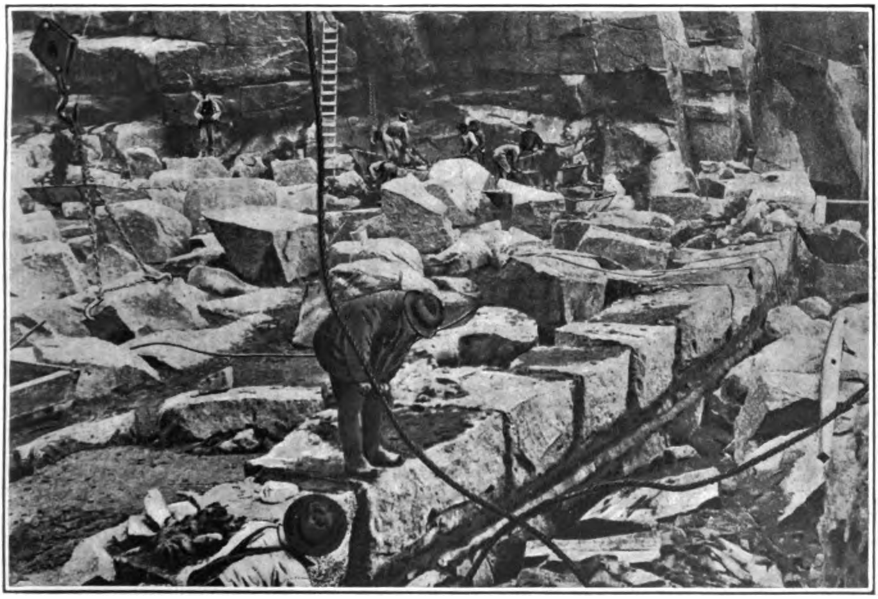
[a] See Fourth Ann. Rept. Reclamation Service, Pls. XXXV and XXXVII.



CONTRACTORS' PLANT AT NORTH ABUTMENT OF PATHFINDER DAM, NORTH PLATTE PROJECT, NEBRASKA-WYOMING, FROM SOUTH SIDE OF CANYON, APRIL, 1906.



A. PROGRESS VIEW OF PATHFINDER DAM, NORTH PLATTE PROJECT, NEBRASKA-WYOMING, SEPTEMBER 16, 1906.



B. PROGRESS VIEW OF PATHFINDER DAM, NORTH PLATTE PROJECT, NEBRASKA-WYOMING, OCTOBER 26, 1906.

The contract for building the dam was awarded September 1, 1905, to the Geddis and Seerie Stone Company, of Denver, Colo. Work on the spillway excavation and preparation of stone for masonry was commenced September 25, 1905, and has continued without interruption to date. The contractors have established a permanent camp near the work and have installed a complete and efficient plant. (Pls. XLVI and XLVII.) Three boilers, having an aggregate of 140 horsepower, furnish power for operating all machinery. Eight derricks are in use, six at the dam and two at the spillway. A cableway across the canyon at the dam site furnishes communication between the top and bottom, and delivers stone, concrete, and mortar to the derricks on the wall. Materials from quarry, cement sheds, and concrete mixing house are conveyed over narrow-gage tracks. Owing to continued high water, no masonry has been laid; but on subsidence of the floods that occur during the spring and early summer the work of construction will proceed rapidly.

While the dam is being built the river is diverted through a tunnel 480 feet in length. This tunnel will serve as the outlet for the water in the reservoir and the discharge will be controlled by two sets of gates operated in separate shafts. The emergency gates will be placed in the upper shaft and the operating gates in the lower.

South of the Pathfinder dam the rock surface drops rapidly, and it will be necessary to build an earthen dike. This dike will have a length of about 1,400 feet, a maximum height of 41 feet and a top width of 20 feet.

The Pathfinder reservoir will extend approximately 23 miles up North Platte River and 15 miles up Sweetwater River. The distance from head on North Platte River to head on Sweetwater River will be approximately 31 miles, and maximum width of reservoir will be about 4 miles. The greater part of lands in private ownership lying within the reservoir limits has been purchased. Areas and capacities of reservoir at contours varying by intervals of 10 feet are shown by the following table:

Capacity of Pathfinder reservoir.

Contour.	Area.	Capacity of section.	Total capacity.
	Acres.	*Acre-feet.*	*Acre-feet.*
5,668			
5,680	2	10	10
5,690	34	180	190
5,700	123	780	970
5,710	290	2,060	3,030
5,720	538	4,140	7,170
5,730	1,077	8,070	15,240
5,740	1,877	14,770	30,010
5,750	2,871	23.740	53,750
5,760	3,834	33,520	87,270
5,770	4,679	42,560	129,830
5,780	5,534	51,060	180,890
5,790	7,070	63.020	243,910
5,800	8,516	77,930	321,840
5,810	9,972	92,440	414,280
5,820	12,333	111.520	525.800
5,830	14,878	136.050	661,850
5,840	18,022	164,500	826,350
5,850	21,774	198,980	1,025.330

INTERSTATE CANAL.[a]

The water stored in the Pathfinder reservoir will be turned into North Platte River and will be carried to the irrigable lands by the Interstate canal (Pls. XLVIII–L). This canal extends from a point near Whalen, Wyo., to Bridgeport, Nebr., and the status of the work is described below.

In section 1, extending from the headworks to the end of the forty-fifth mile near the Wyoming-Nebraska State line, all earthwork has been completed. The canal capacity is 1,400 second-feet at the headworks and 1,200 second-feet at the end of the forty-fifth mile. This part of the canal is located for the most part in rough country, and covers but a small amount of irrigable land.

Section 2 extends from the end of the forty-fifth mile to the end of the ninety-fifth mile, near the township line between ranges 54 and 55 west, at reservoir site No. 1. The capacity of the canal is 1,200 second-feet at end of the forty-fifth mile and 700 second-feet at the end of the ninety-fifth mile. This section is now being built.

Section 3 consists of several reservoirs and the connecting canals, having a length of 4½ miles and a capacity of 500 second-feet. Only surveying work has been done on this section. The reservoir capacities will be ample to provide for the storage of all the water necessary for the lands to be irrigated.

Section 4 extends from reservoir No. 3 to a point near Bridgeport, Nebr., a distance of approximately 68 miles. The final surveys for this section have not been made, but it is believed that the estimated acreage is approximately correct.

The excavation work on the first 45 miles of the Interstate Canal has been completed, and water has been turned into the canal. The structures have not been completed, but work on them is in progress and the contractor expects to finish within the contract time. The bids for the excavation for the second division of the Interstate canal were published in the Fourth Annual Report, but as these were received late in the year the contracts had not been awarded when the Fourth Annual Report was written. Contract for divisions 1, 2, 3, 4, 5, and 8 was awarded to the Deadwood Construction Company, which has completed about 24 per cent of the work. The contract for division 6 was awarded to James O'Connor, and about 44 per cent of the work has been finished. The contract for division 7 was awarded to the Burke Construction Company, which has completed about 25.7 per cent of the work.

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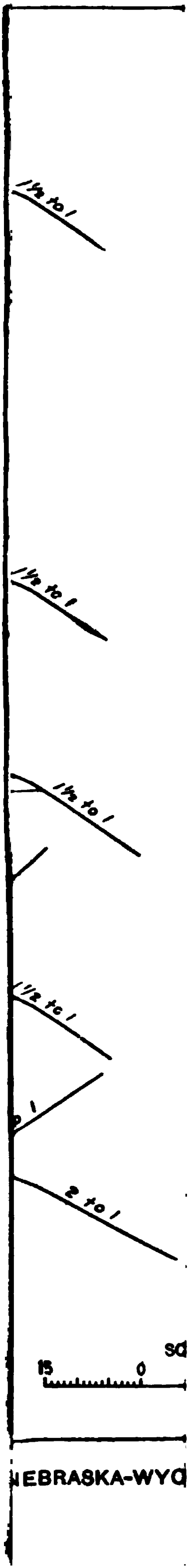
[a] See Fourth Ann. Rept. Reclamation Service, Pl. XXXVIII.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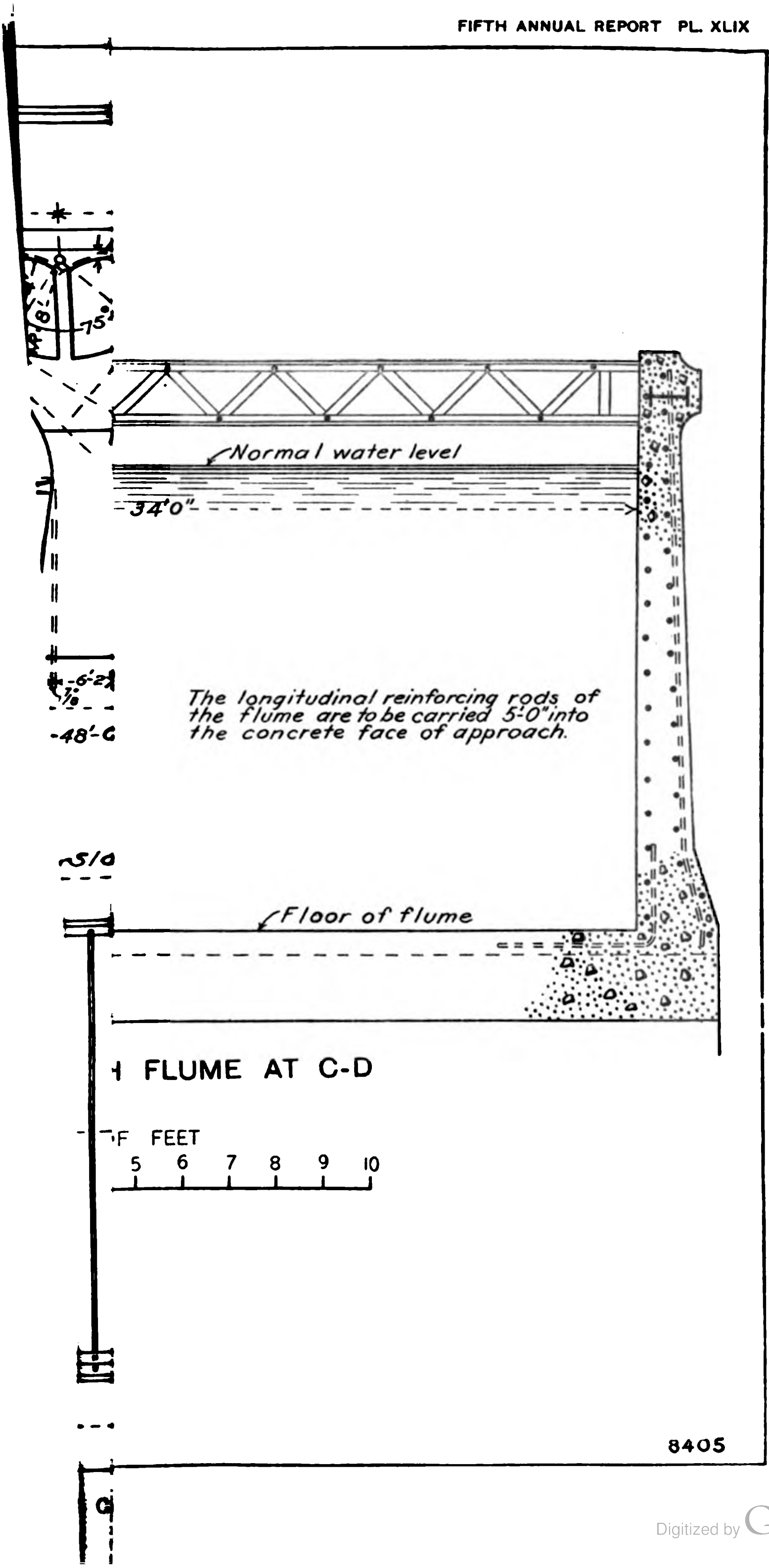

The longitudinal reinforcing rods of the flume are to be carried 5'-0" into the concrete face of approach.

FLUME AT C-D

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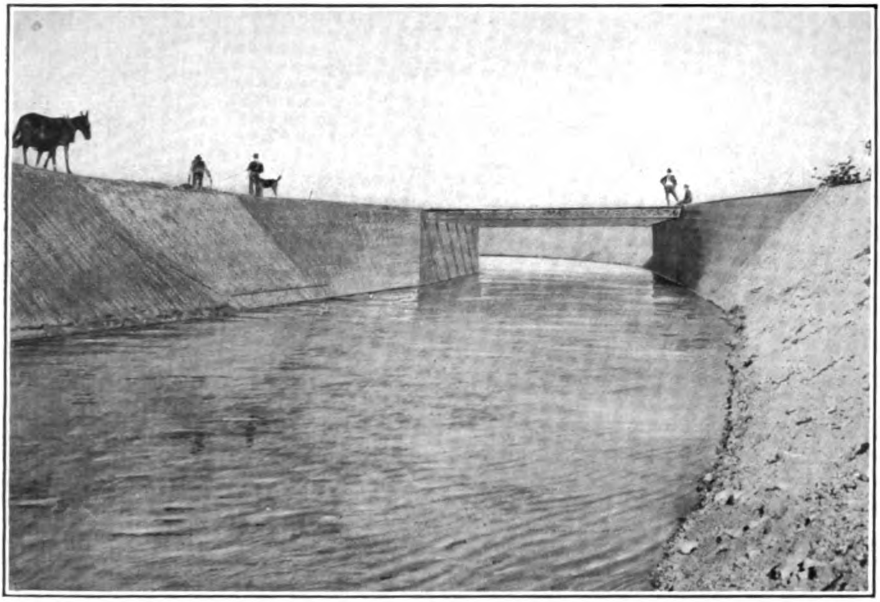
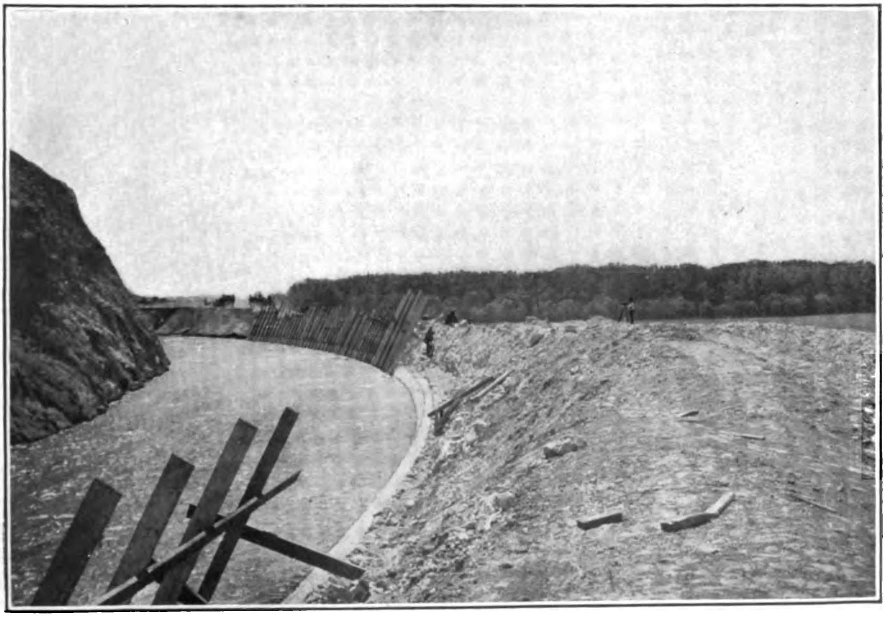


A. FLUME ACROSS COTTONWOOD WASH, INTERSTATE CANAL, NORTH PLATTE PROJECT, NEBRASKA-WYOMING.

Looking upstream, about 2 feet of water in canal, June 17, 1906.



B. LINED SECTION OF INTERSTATE CANAL AT MOLLIES FORK, NORTH PLATTE PROJECT, NEBRASKA-WYOMING, SHOWING FORMS IN PLACE, JUNE 17, 1906

DISTRIBUTION SYSTEM.

Bids for building the first system of laterals were opened at Mitchell, Nebr., on June 15, as follows:

Bids opened June 15, 1906, at Mitchell, Nebr., for excavation on distribution system, North Platte project.

[Specifications No. 91.]

Section.	Quantity, class 1 (cubic yards).	James O'Conner.			Maney Bros. & Co.		
		Price for class 1.	Total for class 1.	Total for section.	Price for class 1.	Total for class 1.	Total for section.
1	129,800	$0.20	$25,960.00	$26.220,00	$0.175	$22,715.00	$22,975.00
2	37,000	.235	8,695.00	10,350.00	.225	8,325.00	9,980.00
3	37,900	.265	10,043.50	11,728.00	.26	9,854.00	11,539.00
4	79,900	.225	17,977.50	18,912.50	.18	14,382.00	15,317.00
5	65,000	.23	14,950.00	15,965.00	.175	11,375.00	12,390.00
6	94,000	.165	15,510.00	15,845.00	.175	16,450.00	16,785.00
7	32,000	.23	7,360.00	7,845.00	.245	7,840.00	8,325.00
8	76,400	.18	13,752.00	14,072.00	.19	14,516.00	14,836.00
9	53,000	.21	11,130.00	11,615.00	.22	11,660.00	12,145.00
10	19,000	.28	5,320.00	5,655.00	.29	5,510.00	5,845.00
11	20,300	.30	6,090.00	6,350.00	.31	6,293.00	6,553.00
12	24,400	.30	7,320.00	7,580.00	.31	7,564.00	7,824.00
13	37,500	.25	9,375.00	9,710.00	.26	9,750.00	10,085.00
14	11,300	.24	2,712.00	2,972.00	.225	2,486.00	2,746.00
Total				164,819.50			157,345.00

Prices for excavation, classes 2, 3, and 4 and for overhaul were the same by both bidders on all sections of work, as follows: Excavation, class 2, $0.75 per cubic yard; excavation, class 3, $0.80 per cubic yard; excavation, class 4, $0.90 per cubic yard; overhaul, $0.015 per cubic yard, per 100 feet.

As these prices were deemed excessive, the bids were rejected and informal proposals were requested from a number of contractors. It is probable that contracts for the construction of the second system will be awarded early in 1907. The area embraced under each system is approximately 40,000 acres. The first system should be completed in time for irrigation in the spring of 1907, and the second system in time for irrigation in the fall of 1907.

DIVERSION DAM.

The diversion dam (Pl. LI–LIII) will be of concrete, gravity type, with a varying height above bed rock of from 10 to 20 feet. This dam will divert water into the Interstate canal and will also be available for a canal on the other side of the river, if such a canal is deemed necessary. The headworks will be of reenforced concrete, with cast-iron gates. From the southern end of the concrete dam will extend an earth embankment 2,000 feet in length, with a maximum height of 18 feet.

IRRIGABLE LANDS.

The following table shows the distribution of the irrigable lands:

Lands included in North Platte project, Interstate canal.

	Acres.	Per cent.
GENERAL.		
Total	382,573	
Private	212,173	55.4
Public	170,400	44.5
Irrigable	281,918	78.6
Nonirrigable	100,655	21.4
PRIVATE LAND.		
Total	212,173	
Irrigable	162,018	76.4
Nonirrigable	50,155	23.6
PUBLIC LAND.		
Total	170,400	
Irrigable	119,900	69.0
Nonirrigable	50,500	31.0
IRRIGABLE LAND.		
Total	201,918	
Irrigable Interstate only in Nebraska	129,106	45.8
Irrigable Interstate only in Wyoming	11,294	4.0
Whalen Falls canal permit	13,300	4.7
Other canals in Wyoming	1,299	.5
IRRIGABLE LAND—continued.		
Farmer's canal	75,771	26.8
Other canals in Nebraska	51,148	18.2
Subscribed under Interstate only	10,378	3.68
Not subscribed under Interstate only	24,622	8.74
Public, irrigable	119,900	42.5
Private, irrigable	162,018	57.5
NONIRRIGABLE.		
Total	100,655	
Under Interstate only	48,000	47.7
Under Whalen Falls canal	6,407	6.4
Under other canals in Wyoming	7,800	7.7
Under Farmers' canal	20,000	19.9
Under other canals in Nebraska	18,448	18.3
Subscribed under Interstate only	3,982	4.2
Not subscribed under Interstate	30,414	30.2
Public	50,500	50.2
Private	50,155	49.8

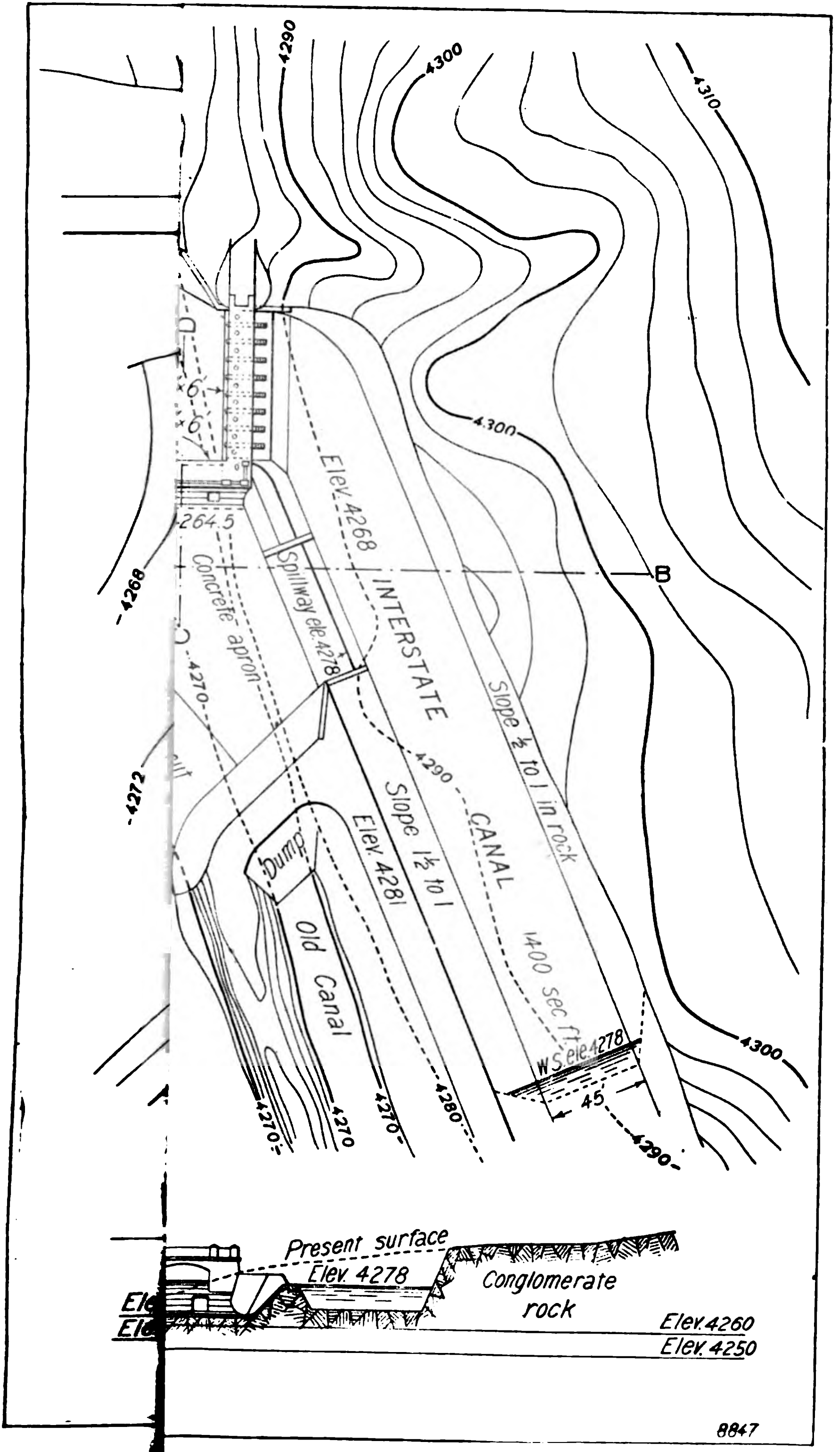
Water sufficient for the irrigation of lands under the first section of the Interstate canal, 45 miles in length, was ready for delivery June 20, 1906. The area irrigated under the canal, including the lands in Wyoming, should amount to approximately 60,000 acres in the spring of 1907, 100,000 acres in 1908, and probably 125,000 acres in 1909.

RIGHT OF WAY.

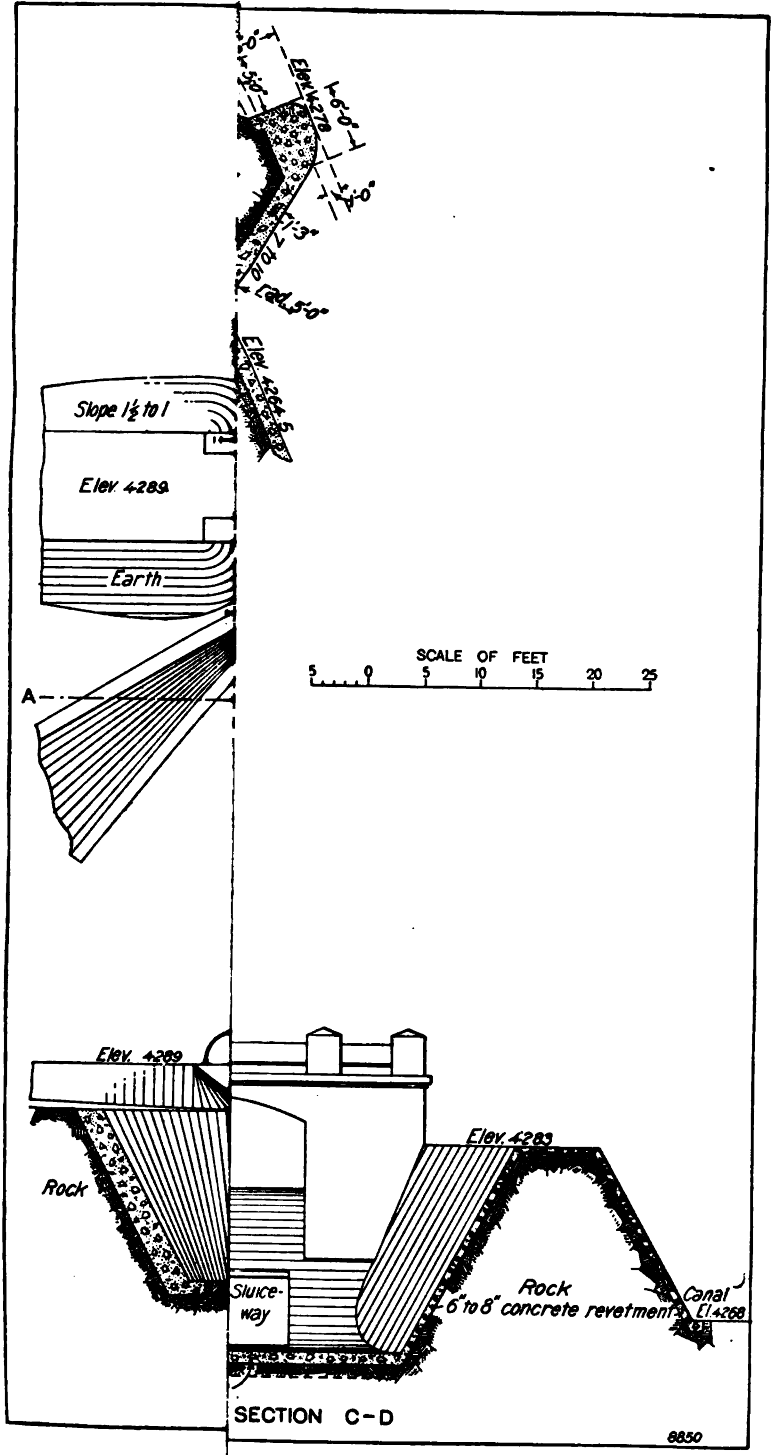
Surveys for the Interstate canal in Wyoming showed that the only feasible location for a considerable distance from the river was owned and occupied by the North Platte Canal and Colonization Company, which had constructed a canal of about 20 miles in length for the purpose of irrigating tracts in private ownership and lands subject to the Carey Act. The company had made a contract with the State for the irrigation of these lands, and the State in turn had made a contract with the United States under the provisions of the Carey Act. An agreement was made December 22, 1904, between the Secretary of the Interior and the company for the use of this right of way for constructing the Interstate canal, the original intention being to enlarge the existing canal—known as the Whalen Falls Canal—in the course of the work. Owing to the natural features of the country, however, this proved to be impossible, and the new canal was constructed independently of the old, although following approximately the same right of way for 20 miles.

LITIGATION.

On April 8, 1905, Heyward G. Leavitt appealed from the decision of the State board of irrigation of Nebraska rendered February 14, 1905, approving the application for the use of the waters of North



TTE PROJECT, NEBRASKA-WYOMING.


6'-0"
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Rock
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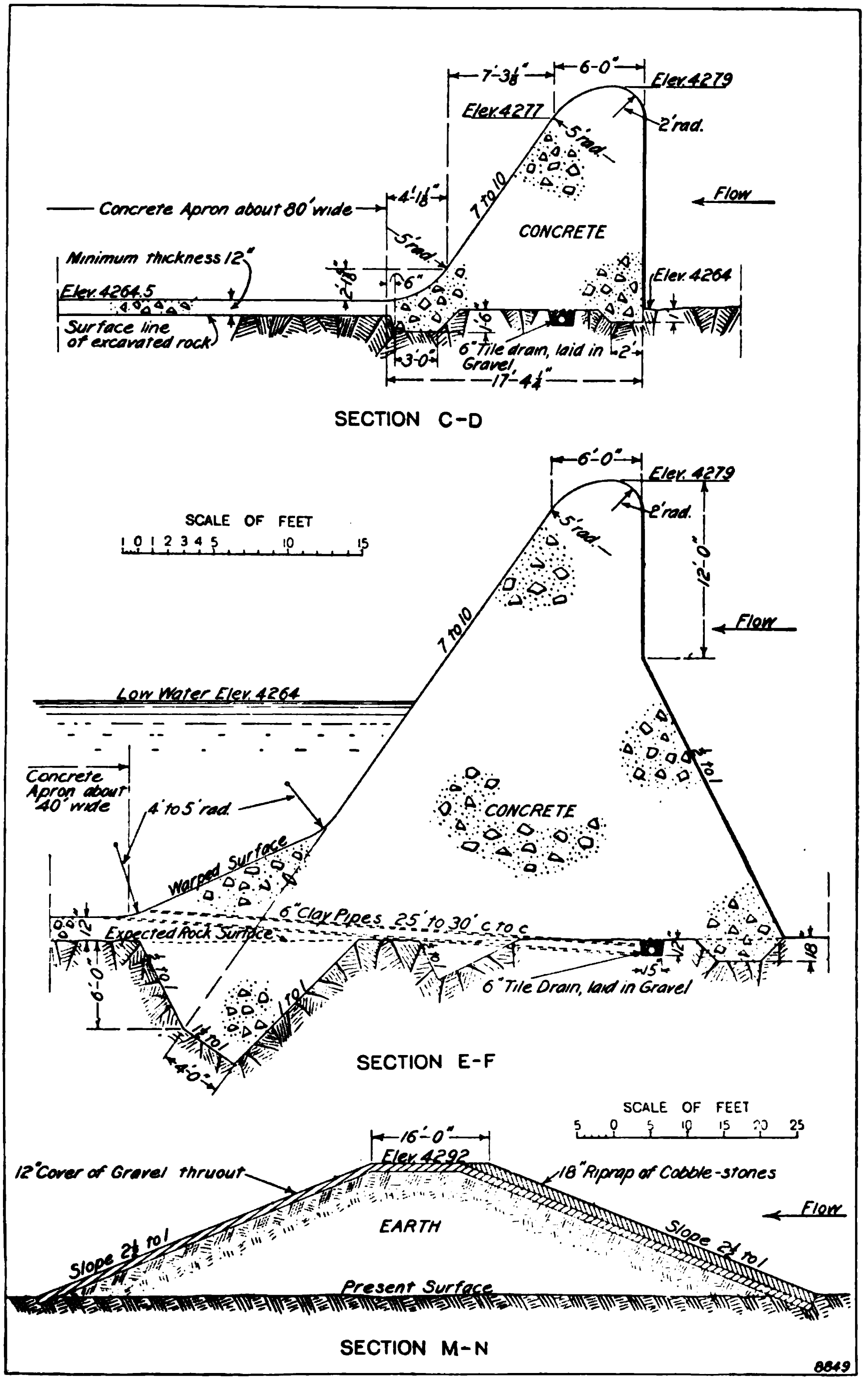
SECTION C-D



SECTIONS OF DIVERSION DAM IN NORTH PLATTE RIVER, NORTH PLATTE PROJECT, NEBRASKA-WYOMING.

Platte River, made on behalf of the United States, and rejecting the application of the said Heyward G. Leavitt for a right to use the waters of the same river. This action was brought in the district court of Scottsbluff County, Nebr., and was removed to the United States circuit court for the district of Nebraska, July 11, 1905, and is now pending in that court.

EXPENDITURES.

The expenditures on the North Platte project are summarized in the following tables:

Expenditures, according to physical features, on North Platte project to June 30, 1906.

Features.	Engineering and administration.	Building.
Incidental structures:		
North Platte pile bridge	$221.52	$3,553.64
Temporary canal structures	1,986.74	4,929.14
Offices, cottages, lodging and boarding houses, warehouses, corrals, etc., at Pathfinder	289.53	6,290.69
Offices, cottages, lodging and boarding houses, warehouses, corrals, etc., at Mitchell and Wyncote	....	8,574.41
Irrigation structures:		
Pathfinder reservoir, lands submerged	378.10	5,803.80
Pathfinder dam and spillway	7,566.26	48,472.38
Pathfinder outlet tunnel	3,991.17	33,259.75
Pathfinder gates	533.17	....
Interstate diversion dam	981.48	....
Interstate canal	33,709.73	628,878.22
Distributing system	12,735.12	....
Irrigable lands:		
Farm unit subdivision and soil examination	2,354.57	....
Examination of project as a whole	73,332.41	....
Administration of project as a whole	28,265.11	....
Maintenance and operation	1,653.32	....
Total	167,998.23	739,762.03
Grand total	....	907,760.26

Expenditures, according to purpose and nature, on North Platte project to June 30, 1906.

[Total, $907,760.26.]

	Services.	Traveling.	Subsistence.	Equipment.	Materials.	Supplies.	Rent and storage.	Forage.	Job work.
Engineering:									
Examination	$26,706.88	$3,998.51	$4,926.65	$7,770.72	$0.40	$2,251.46	$43.51	$1,235.40	....
Survey and inspection	44,757.11	5,339.89	8,320.34	11,639.28	4.10	5,353.23	191.11	5,405.91	....
Design	6,619.61	475.41	134.73	298.79	....	225.49	26.45	.25	....
Subdivision	1,936.46	208.31	4.75	80.26	....	87.59	36.45	.75	....
Building:									
Rights and property	681.54	153.75	41.20	14.00	....	8,436.10	4.00	4.35	....
Building	67,337.33	3,142.62	13,645.46	12,395.42	14,894.70	9,576.53	709.49	5,723.11	$603,002.43
Maintanance	1,397.53	....	20.50	....	104.54	127.80	....	2.95	....
Administration	20,445.45	1,994.17	216.10	1,871.23	....	2,871.05	866.86	.25	....

NEBRASKA.

SOUTH PLATTE UNDERFLOW INVESTIGATIONS.

The investigation of the feasibility of obtaining water from the underflow in the valley of South Platte River was brought to a close late in the field season of 1905, and is described in the Fourth Annual Report. The work in this area showed that private capital can best develop the water resources existing in the ground waters and that there is no necessity for plants requiring large capital or Government aid. The length of the valley and its limited width render it impracticable to build a single comprehensive irrigation system. A final report on the investigations in the South Platte Valley has been published by the United States Geological Survey as Water-Supply and Irrigation Paper No. 184. The summary of the expenditures for this work is given in the following table:

Expenditures, according to purpose and nature, on South Platte investigation to June 30, 1906.

[Total, $2,847.17.]

	Services.	Traveling.	Equipment.	Supplies.
Examination	$997.98	$255.25	$1,206.66	$150.46
Administration	221.00	15.82	....	....

NEVADA.

TRUCKEE-CARSON PROJECT.

GENERAL DESCRIPTION.

The principal facts relating to the Truckee-Carson project are summarized below.

Summary of principal data relating to the Truckee-Carson project.

Counties: Churchill and Lyon.
Latitude: 38° 48′ to 40° 15′.
Longitude: 118° 20′ to 119° 35′.
Townships: 16 to 24 north, range 21 to 31 east, M. D. M.
Irrigable area of first unit: 200,000 acres.
Watershed area: 3,450 square miles.
Average rainfall: 5 inches.
Range of temperature: Maximum, 100°; minimum, 12°; mean, 48°.
Average elevation: 3,950 feet.
Principal products: Alfalfa, cereals, vegetables, fruit.
Nearest railroad: Southern Pacific.
Nearest stations: Hazen, Wadsworth, distance 0 to 30 miles.
Principal market: San Francisco, Salt Lake City, local mines.
Proportion of public land: 70 per cent.
Farm unit: 80 acres.
Character of soil: Sandy loam, clay loam, volcanic ash.
Value of irrigated land: $50 to $100 per acre.
Beginning of survey: 1902.
Kind of headworks: 2 concrete diversion dams.
Reservoir areas: Lake Tahoe, 193 square miles; Alkali Flat, 8,000 acres; Lower Carson, 11,000 acres.
Capacity of reservoirs: Lake Tahoe, 200,000 acre-feet; Alkali Flat, 220,000 acre-feet; Lower Carson, 286,500 acre-feet.
Duty of water: Mean, 2½ acre-feet per acre.

In the following table are listed the contracts entered into for building work on the Truckee-Carson project. This list includes all contracts for excavation, embankment, masonry, and erection of structures, but does not include materials such as cement, steel, timber, etc.

Contracts for building work on Truckee-Carson project to June 30, 1906.

No. of contract.	Contractor.	Feature.	Estimated total value.[a]	Payments to June 30, 1906.	Per cent paid.
1	E. B. & A. L. Stone Co	Main canal, division 3	$250,700	$339,118.80	100
2	C. A. Warren & Co	Main canal, division 1	303,417	476,001.96	99
3	....do	Main canal, division 2	439,670	484,941.29	100
14	Clarence W. Swain[b]	Bridges, district canal	4,288	2,040.00	48
15	Pacific Coast Construction Co.	Excavation, district canal	195,887	254,777.26	100
16	San Francisco Construction Co.	Headgates, district canal	43,220	60,997.50	100
29	....do	Ditches 1, 2, 6	129,587	129,220.29	100
30	Pacific Coast Construction Co.	Ditch 5	43,550	43,436.31	100
31	Utah Construction Co	Ditches 3, 4	117,737	98,239.27	100
57	Edw. Malley[c]	Lake Tahoe	32,200	....	....

[a] For a discussion of advance estimates and final costs, see p. 51.
[b] Contractor in default. Work carried on by force account.
[c] Contract canceled by mutual consent.

The principal works and the irrigable lands embraced in the Truckee-Carson project are situated in western Nevada between the parallels 38° 48′ and 40° 15′ of north latitude and the meridians 118° 20′ and 119° 35′ west longitude from Greenwich. The two principal sources of water supply, Truckee and Carson rivers, head on the eastern slope of the Sierra Nevada in California. These rivers lie in the drainage area of the Great Basin, and none of the drainage or run-off reaches the ocean. The waters drain into more or less saline lakes in the lowest parts of the basin, where they are lost by evaporation. The elevation of the lakes is about 3,900 feet.

The basins of Truckee and Carson rivers are quite distinct, and the rivers drain into lakes or sinks well apart, but at one point a short distance southeast of the town of Wadsworth only a low ridge separates them, and water is easily diverted from one basin to the other.

The water supply available from the Truckee basin is larger than that from the Carson. The latter, however, has much the greater areas of land available for reclamation, and the land is also the more easily reached with water. For these reasons the Truckee-Carson project, as finally decided on, aimed first at the reclamation of land situated in the Carson Sink Valley by the combined waters of Truckee and Carson rivers.

The upper or western portion of the Truckee basin lies on the east slope of the Sierra Nevada. This area ranges in altitude from 5,000 to 11,000 feet, and is mostly covered by forests. The precipitation, mainly in the form of snow, is comparatively heavy, and much the greater part of the water supply is derived from this section, most of which is in California.

The Upper Truckee heads at the extreme south end of the basin. It flows northward and discharges into the south end of Lake Tahoe, which has a length of about 21 miles north and south, with an extreme width of 11 miles and an area of 193 square miles. The lake is cut by the State line, nearly three-fourths of it lying in California and the balance in Nevada. .

The outlet of the lake is on the northwest side, at Tahoe, Cal., where the main Truckee begins. The river has a general northerly and northeasterly course for about 40 miles, as far as Verdi, Nev.; it then flows easterly for 45 miles, passing through the Reno Valley and the Lower Truckee Canyon, to Wadsworth, not far from the low divide between this and the Carson basin. Here it turns abruptly to the north, and after flowing about 20 miles farther, discharges into Pyramid and Winnemucca lakes.

At and near the headwaters of the river in California there are, besides Lake Tahoe, a number of smaller lakes and basins that can be formed into storage reservoirs. The storage of surplus waters in these reservoirs forms an essential part of the full development of the Truckee-Carson project, and a large proportion of the work of investigation and survey for the utilization of Truckee River water has been in connection with these natural sites.

The Carson River basin adjoins the Truckee basin on the southeast and runs nearly parallel with it, the general trend of each being to the north and northeast. Like the Truckee, the Carson obtains the major portion of its water from the east slope of the Sierra Nevada in California. There are a number of possible reservoir sites in this mountainous section, all small, however, and of comparatively small consequence to the project. Out of a large number examined only two were recommended for construction. The others were condemned as being too small, too expensive, or not necessary to the proper control or conservation of the river flow.

The river is formed by two branches, the east and west forks, both of which head near the summit. They run northward and unite in Upper Carson Valley, near Genoa, Nev. The main river runs in a general northeasterly direction for about 80 miles, traversing Upper Carson, Dayton, and Churchill valleys and three intervening canyons to a point in Carson Sink Valley about 5 miles west of Fallon, where it divides. the south branch flowing toward Carson Lake. Three miles farther east the stream again divides, one branch, called New River, runs easterly into a slough called New Slough, or Stillwater Slough, whence it runs northeastward into Carson Sink; the other branch, Old River, flows northeasterly for 18 miles and also discharges into Carson Sink, where the waters are lost by evaporation.

The work of improving the channel of Old River, by straightening, deepening, and widening, so as to carry all the flow of the river and also to receive drainage of the irrigated areas, forms an important part of the project.

Along the main Carson are two large reservoir sites, which, as planned, will form very important parts of the project. The upper one, Alkali Flat reservoir, is a large natural depression north of the river between Dayton and Churchill. The lower reservoir site, called Lower Carson reservoir, is in the valley of the river. Its lower end is at the point where the valley or canyon opens out into the broad Carson Sink Valley, and its upper end is about 18 miles above, in Churchill Valley.

A full record has been kept of the discharge of the two forks and of the main Carson River for the last five years. These, with some intermittent records from 1890 to 1900, enable a very fair estimate to be made of the possibilities of water supply.

The land to be reclaimed lies principally in Churchill and Lyon counties, Nev., between townships 16 to 24 north and ranges 21 to 31 east, Mount Diablo meridian. This area is traversed by the Southern Pacific Railroad, by the Carson and Colorado Railroad, and by the cut-off road from Hazen to Fort Churchill. The Southern Pacific proposes to construct a branch road from Hazen to Fallon, the latter being the center of the area already reclaimed.

The climate is mild, more so than at localities in the same latitude farther east, even to the Atlantic. The mean temperature for both the summer and winter months is several degrees warmer than at Salt Lake City, Utah. As in other portions of the arid West, the proportion of sunshiny days is high. All the natural conditions for a luxuriant vegetable life exist except sufficient rainfall. The principal crops to be raised, for the present at least, will be wheat, oats, alfalfa, potatoes, and the more hardy fruits.

The irrigation system consists essentially of the following features: (1) A main diversion canal for carrying the waters of Truckee River over the low divide to the Carson basin and thence around the west side of the valley to Carson River at the dam site for the Lower Carson reservoir; (2) main distributing canals (Pl. LIV) for diverting water from Carson River below the reservoir to the principal bodies of land in Carson Sink Valley; (3) the lateral distributing system, for the further distribution of water to the lands to be reclaimed; (4) the conversion of Lake Tahoe into a reservoir with a capacity of 200,000 acre-feet for holding part of the water of the Truckee; (5) a reservoir with an approximate capacity of 220,000 acre-feet in the Alkali Flat site north of Carson River for storing surplus water from Carson River; (6) the building of the Lower Carson reservoir, by which 286,500 acre-feet of the combined waters of the Truckee and the Carson may be stored. The main diversion canal and the main distributing canal have been completed, and the laterals are now being built. The building of the Lower Carson and Alkali Flat reservoirs will be accompanied by an extension of the lateral distribution system.

The Truckee canal is designed to carry about 1,200 second-feet of water from the Lower Truckee Canyon into the Lower Carson reservoir, and about 200 second-feet to a point in the canyon convenient for a branch to the Pyramid Lake region.

The canal is 30.9 miles long and is divided into three divisions. Division 1 extends from the head to the 6-mile point, division 2 extends from the 6-mile point to the 13-mile point, and division 3 extends from the 13-mile point to the end. An important part of division 1 is the diversion dam and headworks. There are several expensive concrete structures on divisions 1 and 2, and on division 2 are three tunnels. Division 3 is entirely in open country. All structures are of Portland cement concrete and iron or steel, no wood being used except for minor parts, such as flashboards.

DIVERSION WORKS.[a]

The headworks consist essentially of a diversion dam across the river and of head-gates at the entrance to the canal. The diversion point is in the canyon about 4 miles east of Clarks and 5 miles above Derby, both of which are stations on the Southern Pacific Railway. It is about 10 miles westerly from Wadsworth, which is on Truckee River, but not on the reconstructed line of the railway. The elevation above sea level at the dam is about 4,200 feet.

The dam and head-gate are built as one structure of concrete, reenforced in places. The dam runs squarely across the river, while the head-gate is placed at right angles to the dam, extending upstream from the south end.

DAM.

The dam is designed for the passage of water through it, similarly to a head-gate. It is 155 feet long between abutments. From the main foundation arise 15 piers to serve as posts for the regulating gates, 16 in number. The foundation is 8.83 feet thick and 30 feet wide, up and down stream, by 171 feet long over all. It rests on the natural bed of tight gravel and bowlders. No effort was made to reach solid rock, as it was not necessary. The excavation was carried to an average depth of about 5 feet below the bed of the river, which is about 145 feet wide.

The main piers are 15 feet high, the top being at high-water mark. On the top of each is a smaller pier for the support of the gear for

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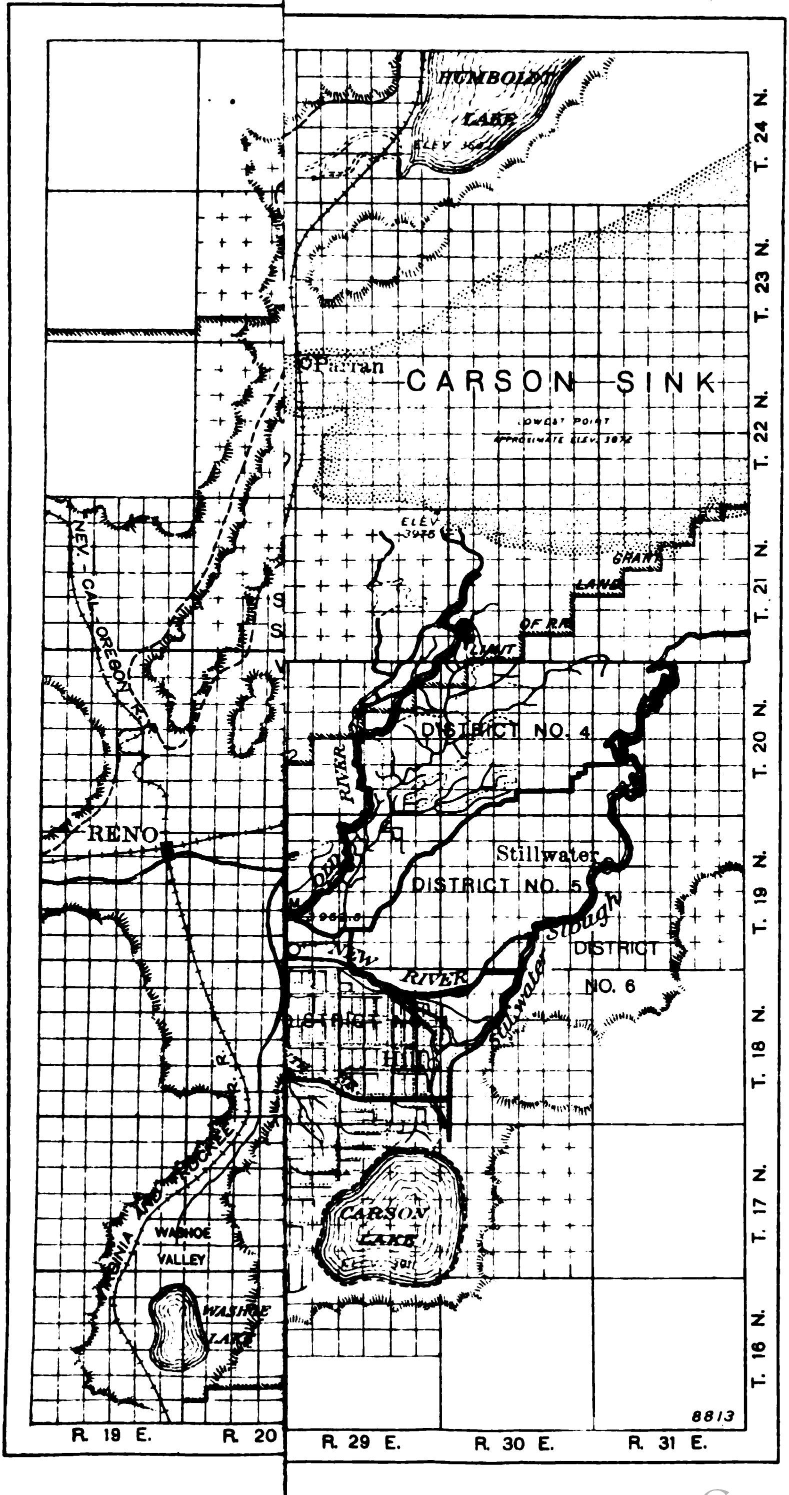
[a] See Pl. XXXV, Third Annual Report.


HUMBOLDT LAKE
ELEV 3909
Parran
CARSON SINK
LOWEST POINT
APPROXIMATE ELEV. 3872
ELEV 3975
GRANT LAND OF R.R. LIMIT
NEV.-CAL.-OREGON R.R.
RENO
DISTRICT NO. 4
RIVER
Stillwater
DISTRICT NO. 5
Stillwater Slough
DISTRICT NO. 6
NEW RIVER
DISTRICT NO.
CARSON LAKE
ELEV 3911
VIRGINIA AND TRUCKEE R.R.
WASHOE VALLEY
WASHOE LAKE
T. 24 N.
T. 23 N.
T. 22 N.
T. 21 N.
T. 20 N.
T. 19 N.
T. 18 N.
T. 17 N.
T. 16 N.
R. 19 E.
R. 20
R. 29 E.
R. 30 E.
R. 31 E.
8813

lifting the gates. The smaller pier is 5.25 feet long, 2.5 feet wide, and 7.33 feet high. The upstream end is semicircular and is set back 1 foot from edge of the main pier. A 14-inch coping projects 6 inches over the top. Two lines (157 feet each) of 7-inch beams, 15.3 pounds weight, spaced 7 inches between webs, run through the coping of the piers and extend along the line of the gate shafts. These beams support the lifting gears and serve to reenforce the concrete arches that extend from pier to pier, forming one continuous section between abutments. The arches are 14 inches thick in the center and flush with the top of the coping. The I-beams are anchored to each pier by a three-fourths inch rod 10 feet long, extending vertically downward in the middle of the pier. At the lower end of each rod is attached a 10 by 10 by three-fourths-inch plate. The anchorage is needed on account of the great upward pressure that may be produced by closing down the gates when there is a large friction to overcome.

There are 16 gate openings, each 5 feet in the clear between the river piers. Each gate is composed of three sections: (1) The lower gate, used alone for the ordinary regulation of water; (2) the upper gate, called into action only when a large amount of water is required to pass; (3) the flashboards, which may be removed for passage of extreme high water.

The lower gates are of cast iron, the body being 1¼ inches thick and strengthened by radial ribs at 45° intervals. They are 5 feet 7 inches wide by 5 feet high, and the clear opening is 4 feet 9 inches high by 5 feet wide. The back (downstream side) is machine faced. Centered over the vertical rib are two lugs for receiving the screw stem, the connection being made by means of a nut on the stem above and below each lug.

The upper gates are of cast iron, the body being 1 inch thick and reenforced by shallow outside and cross ribs. These ribs are machine faced to give smooth contact with the lower gate when the latter is raised. The back of the body is also machine faced where in contact with the guides. The gates proper are 5 feet 9¼ inches wide by 5 feet 3 inches high, and the opening is 5 feet by 5 feet 3 inches. Above the upper gate is a series of 5 flashboards, each 3 by 12 inches by 5 feet 9½ inches and bound with strap iron on the edges. When removed these give an additional opening of 5 by 5 feet.

The gates are operated as follows: The lower gate is raised directly by the screw stem. It slides up the front of the upper gate until it reaches its limit (4¾ feet opening), when it strikes the horizontal flange projecting from the top of the upper gate and further movement raises both gates (one being directly back of the other). The gates can be lifted entirely out of the main guides and removed. The opening between the smaller piers (for all but the two end gates) is such that when the gates are entirely up they can, if emergency should require, be allowed to swing edgewise with the stream, thus offering the least resistance to the current. The flashboards are pulled out at the top, one by one, as the double gate is raised. The 16 openings, each 5 by 15 feet, give a total waterway of 1,200 square feet.

The maximum discharge of the river is probably 10,000 to 12,000 second-feet. The greatest measured discharge occurred on April

16, 1904, amounting to 7,480 second-feet, and the rating table indicates a maximum for that year of about 9,000 second-feet. This is probably the greatest since 1868.

The screw stem of each gate passes up between the I-beams embedded in the arch (before described) and into the pedestal or stand. The stand is of cast iron and has bevel gearing operated by turning a crank by which the power is multiplied six times. One hundred and fifty-seven turns of the handle move the gate 5 feet. The stand has two sets of ball bearings, in which the balls run in grooves between plane rings. One set of bearings takes the downward pressure, which is the sum of the weight of the gate and the friction due to pressure, etc., to be overcome. The other set takes the upward pressure or resistance, which is the difference of the foregoing factors. The screw stem is 2½-inches in diameter, is double threaded, and has a pitch of 1½ inches. It runs through a bronze nut or socket set in the stand.

HEAD-GATES.

The row of head-gates extends upstream from the south end of the dam at an angle of 90°. The supporting structure is an extension of the south abutment of the dam. There are nine gates, spaced 7 feet between centers, and each having a clear opening of 5 feet. The distance between end walls is 61 feet.

The framework of the structure supporting the gates is of steel, and consists of 8 posts and 1 main girder. The main girder is at the top, above the gates, and spans the space between end walls. Its principal office is to take about one-third of the horizontal downstream pressure on the posts, due to the full head of water against the gates. The other part of the pressure is cared for by the feet of the posts being embedded in the foundation. The girder is made of two angles (4 by 4 by ½ inches) in each flange or chord, framed together with diagonals, and with two cover plates of 10 by ½ inches in each chord. The depth is 3 feet and the length 64¾ feet. The system of gates is practically the same as for the dam. Each gate, however, has only two flashboards, of 8-inch width.

The sill of each gate is a 4 by 4 inch timber, set flush in the main concrete sill. This sill is 2 feet and 3 feet 8 inches above the bed of the canal and the floor of the dam, respectively. This is to favor the sluicing through the dam of sand and silt that accumulates in front of it. The bed of concrete here is about 6 feet deep. On the side next the river a curtain wall or cut-off wall (of average thickness of 15 inches) is carried down to the same level as the bottom of the foundation of the dam. On the lower side the sill is sloped down at an angle of 45° to the bed of the canal.

The center line of the canal is swung 55° 30′ downstream from right angles to the row of head-gates, necessitating a curve in the right side of the receiving basin. The approach to the canal proper is made by means of converging sides of warped surfaces, covering a length of 35 feet.

TRUCKEE CANAL IN TRUCKEE CANYON.[a]

GENERAL CHARACTER.

The portion of the Truckee canal in the canyon represents the the most difficult work and the greater part of the expenditure. It includes all of division 1 (6 miles) and 4 miles of division 2. The sides of the canyon for the most part slope at angles ranging from 5° to 30°. The formation is heterogeneous, consisting of earth, gravel, talus, cemented material of various kinds, and several kinds of rock. There is considerable calcareous tufa and some very coarse sandstone. The only really hard rock found is a kind of trap rock. The formation is so much broken, or open and porous, that it is not well adapted for holding water. The only clayey matter present is a fine silt, a characteristic deposit in the old lake bed of all this region. It is the only natural substance available for puddling or for silting up the sides and bottoms of canals.

CONCRETE LINING.

Concrete lining is used under a variety of circumstances: (1) In rock excavations it is employed to make a smoother section, and thus allow of a narrower cross section and consequent reduction in yardage; (2) it is used in light, porous materials and in very broken, seamy, or fissured rock, in order to prevent leakage; and (3) it is employed in places where leakage or washouts might have serious consequences. The standard thickness of lining used was generally about 6 inches, but in one place 4 inches was adopted. It was possible to use 4 inches where the rock was not too much shattered or too rough. All lining is brought up to an elevation 2 feet above water line, at the grade for top of banks. In placing the concrete on the sides the framework of the form was first put up, and then the concrete was put on in layers about 1 foot thick and tamped with spade tamps, the lagging on back of the framework being added only as needed to keep above the concrete. Pockets or caved-in places in the slopes were usually brought out to the proper line back of the concrete by filling with broken rock and cobblestone, the wall for the same being kept a few feet above the concrete. This back filling was done by hand, as carefully as in paving or in a dry wall, and was classified as riprap. For much of the lined sections a "binder" was used. This consists of a projection from the back of the lining, usually about 6 inches thick (vertically) and extending back to the earth or rock side. On some portions of lined canal this was continuous, usually along the midsection of the side which appeared to need it. In bad places two binders were used, at vertical intervals of about 5 feet. In other places only detached strips of it were put in. The binder serves (to some extent) to anchor the slope lining, to make the lining less liable to rupture from pressure of loose materials behind it, and to break up the continuity of moving or sliding ground behind.

The warped surface approaches of lined sections and of structures were usually, unless supported by solid rock, strengthened in two or three places in the back by counterforts or buttresses. These were about 2 feet wide and ran up the slope. On excavated slopes they were run into the formation a little, and their back was stepped up instead of using a straight slope. Their depth was from 18 inches to 4 or 5 feet, and the usual spacing was 10 feet.

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[a] See Third Ann. Rept. Reclamation Service, Pl. XXXVII.

The amount of concrete per linear foot of canal varied all the way from 0.6 cubic yard to 1.4 cubic yards, depending on width and slopes and on the thickness of lining. On the section with 20 feet width and ½ to 1 slopes a thickness of 6 inches requires 1 cubic yard. The total cost to the Government of all items for the concrete was about $9 per cubic yard.

TUNNELS.

There are four tunnels on the Truckee canal, all on division 2. As the material to be encountered was known to be variable, three methods of lining tunnels were prescribed in the specifications: (1) Temporary timbering was put in during excavation and the permanent lining of concrete was put in afterwards, the timbers remaining in the concrete; (2) no timbering was put in or the timbers were moved when the tunnels were lined with concrete; (3) in hard rock the tunnels were plastered with a coat of cement plaster. The first method was used on all the work except for No. 2 tunnel, where the second method was used. The finished section of concrete by either methods 1 or 2 is 12 feet wide, 12 feet high to the springing line, and has a three-centered arch 3.35 feet high. The water section is 13 feet deep and has an area of 155.9 square feet. The grade through the tunnels is 1 in 1,500, or 0.067 foot per 100 feet. In tunnels 1 and 2 the calculated velocity, with value of "*n*" in Kutter's formula = .012, is 8.10 feet per second and the discharge is 1,263 second-feet. In tunnel No. 3, which has a slightly different section, the calculated velocity is 8.03 feet per second and the discharge is 1,245 second-feet. The upper approach to each tunnel has a fall of 0.2 to 0.4 foot, to accelerate the velocity for the tunnel. A fall of 0.4 foot is given to a 40-foot entry chamber, and a fall of 0.2 foot to a 25-foot entry chamber. For a short distance below the exit end the open canal is paved, in order to prevent scour of the bottom and sides until the velocity is reduced.

Tunnel No. 1 is about 6½ miles from the head of the canal. It is 901 feet long between portals. About 70 feet of the upper end is on a 20° curve. At a point about 160 feet from the lower end another 20° curve extends inward for about 160 feet. Under natural conditions this tunnel would not have been built, though it saves much side-hill work and some distance, but the location of the railway required it. The portal cuts are about 80 feet deep. The material encountered was a dark, hard, flinty rock, with many seams and slips. The greatest height to surface of the ground over the tunnel is probably as much as 200 feet.

Tunnel No. 2 is about 7.4 miles from the head of the canal. It is 308.7 feet long, all on tangent, and the portal cut has a length of about 75 feet. The topography here determined its use, aside from the obstruction offered by the railway to an open canal. This tunnel was constructed without timbering. The material encountered was a red rock, not hard but compact, tough, and without seams, so that it broke up "short" in blasting and could be cut close to line. The greatest elevation of the surface over the tunnel grade is only 58 feet.

Tunnel No. 3 begins 8.5 miles from the head of the canal. It is 1,515 feet long. The portal cuts are about 35 and 40 feet long at the upper and lower ends, respectively. The greatest vertical distance from the tunnel grade to the surface was just 100 feet. A slight modification of the cross section first designed was used. The height to the springing line is made only 11 feet, which allows of a shorter radius (only 7 feet) being used for the simple part of the arch, thus securing better arch effect. The arch lining is also made much thicker. The material driven through was earth all the way, and no powder was used. For about 150 feet at the exit end (east end) there was a loose sand, without admixture of adhesive material, which ran very freely, and the difficulties were so great that the progress with two shifts was less than 1 foot per day. Nearly all the remainder of the tunnel was through silt or cement gravel that worked easily and stood well. During one month 472 linear feet were driven from both headings. The greatest progress per month at one end was 294 feet.

Tunnel No. 4 is located at 7.6 miles from the head of the canal. It is required to pass the water of a wasteway at this point under the railway track to discharge into the river. The water drops down to the head of this tunnel from the wasteway through a shaft 49 feet deep.

STRUCTURES.

In the canyon there are, besides the headworks, three very elaborate structures. Two of these are wasteways, and the other one consists of the headworks for the Pyramid Branch canal.

UPPER WASTEWAY.

The first or upper wasteway is 4.6 miles from the head of the canal. The lined-canal section adjoining the wasteway basin has 20.8 feet base and 1 to 1 slopes. The basin is formed by dropping the canal bed 6 feet vertically for a distance of 45 feet and by widening it on the lower side, making a chamber 45 by about 36 feet on the bottom and 19 feet deep when the canal is full. In the wall forming the left or lower side of the basin are five wasteway openings, each 5 by 5 feet in the clear. Their bottom is at the floor of the basin, making a head of 14 feet over the top. The openings are separated by piers 4 feet wide and 10 feet long, with the upstream ends semicircular. The spaces between the piers, above the top of the openings, are closed up by 2 feet of reenforced concrete set back 2 feet from the upper edge of the piers.

The passage of water through each of the five openings is regulated by a gate of the Taintor pattern. In simple terms, this may be called a circular gate. It consists of a circular arc revolving around a horizontal shaft, to which it is attached by radial arms, the whole forming in outline a sector of a circle. The arc is convex toward the water pressure, which is transmitted as thrust by the radial arms directly to the shaft. The gates here are made as follows: The center of the shaft is at the same level as the top of the gate opening. The radius to the ouside or bearing surface of gate is 7 feet 5⅞ inches. The arc has a net length of 5 feet 5⅜ inches, and subtends an angle of 41° 53′. The required net horizontal length of the gate surface is

5 feet. The steel shaft is 4 inches in diameter and 7 feet, 1¾ inches in length. From the shaft radiate three cross frames, constructed of 3 by 3 by ¼ inch angle irons. At the outer ends these support the circular part of the gate. This is built up of angles, plates, and 5-inch **I**-beams. The sheathing by which the water is excluded is of one-fourth inch steel plate. When entirely closed the lower end of the gate has a contact of about 4 inches with a guide strip set in the floor, and the upper end has a light contact with a strip next to the top of the opening. The side edges of the gate also have contact with corresponding strips on the sides of the concrete piers. The lower portion of the piers for over 5 inches on each side is recessed, to make room for the full width of the gates, which is about 5¾ feet. The contact or bearing surfaces of the gate and the guides are made of bronze five-eighths inch thick.

The gate is raised by a 7/16-inch steel-wire cable, attached to its upper edge. The cable extends upward to and around a grooved drum on top of the wall between piers. The drums for all the gates are keyed with a 2½-inch steel shaft. Power is applied to the shaft through a pinion and geared wheel at either end of this shaft, which is 43½ feet long. The pinion is turned by a crank by hand. The crank radius is 18 inches, the pinion is about 6 inches, and the geared wheel 32 inches in diameter, while the drum is 8 inches, making the multiplication of power 24. The power available for lifting a gate, even if each of the two gears be worked, is too small to readily lift the gate without some other aid. The entire length of shaft has to be turned, and considerable power is required for this alone, besides overcoming other frictions. The gates are counterweighted as follows: A 7/16-inch cable leads from the same point of attachment up to two 18-inch sheaves, on a level with top of the piers and 3 feet apart. From the rear sheave the cable leads down to a bucket of about 15 cubic feet capacity. This is filled with water to give the required weight. This nearly counterweights the gate, so that with the gear and shaft in smooth running order the gate can be easily and quickly lifted. To stop the gate after it has entirely cleared the opening, a bumper is bolted to the side of the pier on either side, which catches the edge of the gate. The bumpers are ordinary cast-iron brackets. To lower it the water in the bucket is let out through a ¾-inch globe valve, when the unbalanced weight of the gate at once brings it down. The total weight of the gate (part of which is borne by its shaft) is about 1,250 pounds. The water pressure does not increase the resistance to lifting, but rather tends to decrease it by easing the contact between the gate and its guides.

LOWER WASTEWAY.

The lower wasteway (No. 2) is located 7.6 miles from the head, or 3 miles below No. 1. The canal section is in solid rock, lined with concrete, and it has a base of 8.9 feet and side slopes of ½ to 1. The basin is formed by lowering the bottom of the canal 6 feet for a distance of 45 feet and by widening it on the lower side. The size of the basin is thus 45 by about 16 feet in the bottom, and the water is 19 feet deep when the canal is full. The system of gates and structure containing them are practically the same as for the upper wasteway.

The waste water passes under the railway track by means of a tunnel. The railway track here is only about 80 feet from the lower side of the canal section, and it is 38 feet lower than the water level of the canal.

The water coming through the gates pitches down a short incline into a basin which is 10 feet wide and 45 feet long. The upper side line of this is the line of the backs of the piers. In the middle of this basin is a shaft, 10 by 12 feet, for carrying the water down into the tunnel. From the ends to this shaft the floor is pitched 3 feet, as is also the floor of the passages between the piers. This causes a more rapid concentration of the movement to the shaft. The shaft is vertical, and the drop from the bottom of the receiving basin (on the canal line) to the bottom of the tunnel is about 47 feet. The bottom of the shaft is 6 feet lower than that of the tunnel, to provide a water cushion for the falling water. The water passes through the tunnel and thence through a short open section of concrete, when it is turned loose to run down the rocky slope to the river. The horizontal distance from the center of canal to the river is about 275 feet, and the drop from the water surface in canal about 120 feet. The vertical distance from the railway track down to the tunnel arch is 12 feet.

HEADWORKS OF PYRAMID BRANCH CANAL.

Six miles from the head of the canal, at the end of division 1, there is provided a take-off for the canal which is to serve the Pyramid Lake area. This consists essentially of: (1) A set of head-gates (more properly, check gates) in the main canal, for use in holding back the water when required to give a good head for turning it into the branch canal; (2) the head-gate of the branch canal itself; (3) the supporting structures, approach sections of canal, etc.

The adjoining section of canal above the structure has a base of 18 feet and side slopes of 2 to 1. By a warped-surface section 30 feet long this is transformed into a basin 40 feet wide, having vertical walls. The center line of the canal below (to which the main gates are at right angles) makes an angle of 21° 18′ with the canal above, and on account of the widened section at the gates no curve is used in the canal. The branch canal gates are so located with respect to the deflection that the entry of water into them is facilitated.

The main canal gates consist of six gates, each closing an opening 5 feet wide by 13 feet high. The gates are the same as those used at the head of the main canal, but the depth of flashboards is 3 feet instead of 1 foot 4 inches. The steel girder across the tops of the gate openings also has practically the same section as the one at the headworks, only it has but one cover plate on each chord. Its length is 43¾ feet. The five posts are also the same, and posts and girder are inclosed in concrete of the same section. The abutment at the right or upper side has a thickness of 3½ feet at top and 7 feet at bottom, and is carried down to a depth of 1 foot below the bottom of the floor.

At the left side, on the upstream side of the abutment, is the set of two gates at the head of the branch canal. These are the same as used elsewhere, but the total height of gate opening is only 10 feet. In place of built-up girders and posts for taking the water pressure against the gates the following is used: Across the section (14 feet wide) and above the level of the gates are stretched tour lines of old 60-pound railroad rails, at vertical intervals of 2 feet. These are embedded in a solid section of concrete, 2 feet 1 inch by 8 feet high. The concrete post between the gates is of the same section as used elsewhere (2 by 3½ feet). The strain against it is taken by two upright railroad rails, 17 feet long, placed near the lower face. These rails are bent back 4 inches at the post. The lower and upper portions are in a straight line, the upper portion coming just in front of the horizontal rails so as to have a bearing on them. The part of the post above the top of the gates is simply a pilaster on the face of the concrete bulkhead just mentioned. The concrete arches at the top, in which are embedded the two channel beams that support the stands and stems for raising the gates, are restricted in width to the space in front of the bulkhead, about 16 inches. The lower side of the abutments was stepped down to the foundations and left so, the intention being to extend walls out from these to inclose a fore bay for the inverted siphon to carry the Pyramid branch across the canyon when the branch is built.

Below the main gates the section of the basin is transformed into a canal section in a distance of 30 feet by warped surfaces. The canal section is 13.4 feet wide and has side slopes of 2 to 1. The warped surfaces here and also the two at the upper end are reenforced with steel.

FARM TAKE-OFFS.

At two places in the canyon the canal is tapped directly to supply water for two farms in compensation for diverting all the water at the dam. One of these "take-offs" is located in a lined section of canal, and the other in an ordinary section. The outlet consists of a 15-inch vitrified pipe that taps the canal 3½ feet above the bottom. This runs through the embankment to the lower side where is placed a receiving box. As the water leaves this it is measured over a weir. At the head of the pipe is inclosed a large block of concrete, and collars of concrete are placed at frequent intervals through the embankment. The admission of water from the canal is regulated by an iron gate which moves up and down the slope. An iron rod extends up to the top of the slope, where it is provided with a handle.

TRUCKEE CANAL BELOW TRUCKEE CANYON.

GENERAL CHARACTER.

At a point about 10 miles from the headworks the canal reaches the end of the Truckee Canyon, and comes into a wide valley. Here the work was much simpler and easier and no structures were required. The canal lies on the gentle slope which has tapered out from the foothills. The canal discharges into Carson River, near the dam site for the Lower Carson reservoir, at a point 30.9 miles from the head. This terminal point is a little west of south of Hazen, and 7 miles distant.

TERMINAL CHUTE.

Pending the building of the dam for the Lower Carson reservoir, the canal water is discharged into Carson River by means of a temporary flume or chute that has been built from near the end of the canal down the hillside to the river at a point about 1,000 feet below the dam site. The arrangement includes the following features: (1) A head-gate for tapping the main canal; (2) a section of canal leading from the main canal to edge of the hill; (3) a second head-gate for connecting with the flume; (4) a section of flume 90 feet long which contracts in width from 22 to 10 feet, while the grade is changed from level to the steep incline by means of a vertical curve; (5) a uniform section on the steep incline; (6) another vertical curve section by which the incline is changed to the horizontal, whence the chute discharges into the river.

The structures were built of lumber. The upper head-gate is for regulating the outflow of water when it is desired to shut off all or part for a short while. The section of canal leads to the lower gate (about 360 feet from the main canal.) This gate effects a connection with the flume, and also serves the purpose of preventing a greatly increased velocity in the canal approach to the flume which might have a scouring and undermining effect on the bottom and sides. Regulation in both gates is made solely by flashboards. Below the lower gate is a 90-foot section of flume in which the width is reduced by converging sides from 22 to 10 feet and the depth from 10 to 6 feet. Part of this reducing portion is on a vertical curve, by which latter the grade of the flume is increased to 30 feet in 100 feet. There is 244 feet (horizontal distance) on this grade, in which the flume (of ordinary rectangular section) is 10 feet wide by 5 feet deep. Below is another vertical curve by which the flume is turned up to the horizontal in a distance of 43 feet. This curve is for the purpose of throwing the stream well out into the river, the bed of which is about 28 feet lower than the end of the flume. With 1,000 second-feet of water running in the flume the theoretical velocity on the incline would be about 80 feet per second, with which the stream would strike the river bed about 65 feet from the end of the flume. The total fall from the canal to end of flume is 92 feet, making about 120 feet to bed of the river.

The mud sills of the flume and all lining of the flume and head-gates are of redwood, which was used for the lining because it warps less than pine. Oregon pine was used for other parts of the structure. The lining of the flume and head-gates consists of one thickness of 2-inch plank and one of 1-inch plank, the latter next the water. In the narrow section of flume (10 feet width) both layers are 1 inch. In this double lining both the longitudinal and butt joints are broken. For most of the flume the stringers rest on sleepers placed directly on mud sills, for a portion at the lower end trestle bents, well braced, have to be used. The stringers and sleepers or caps are well-dapped into each other, and also cleated, so as to form a continuous line of stringers. Near the lower end an anchorage is used, to take any downhill thrust of the structure. This consists of three ¾-inch rods (with turnbuckle), carried from a cap back into the hillside and attached to a timber 6 by 12 inches by 20 feet buried over 6 feet under the surface. An excellent anchorage is also afforded at upper end of the flume by having it firmly connected with the head-gate, which is founded deep in the ground, and also by the backfilling against the converging sides of the flume.

DISTRIBUTING CANALS.

The main distributing canals form the second essential part of the Truckee-Carson project. Their office is to divert the waters from Carson River to the main bodies of land to be irrigated. At present the principal body of land is that south of Carson River, in the neighborhood of Fallon.

The diversion for both sides of the river is made at a point about 4 miles above (west of) Leetville post-office, and 5 miles below the dam site for the Lower Carson reservoir. The canal on the south side of the river was designed to have a capacity of 1,500 second-feet, and that on the north side of 450 second-feet.

HEADWORKS.[a]

The headworks consist of a diverting dam across Carson River, and of intakes at the north and south ends for admission of water to the north-side and south-side canals, respectively. At the diversion point the river lies between rather low banks. The fall is about 6 feet per mile. The formation is all earth, with gravel but no bowlders in the river bed. Rock does not outcrop anywhere near here nor in the main valley to the east, and it is probably covered to a very great depth.

The dam is of concrete, and in general design, arrangement of gates, etc., closely resembles the Truckee dam. The bed of the river here has an average elevation of about 4,025 feet above sea level. The span between abutments of the dam approximately corresponds with that between banks of the original channel, and the floor level is about 1 foot lower than the mean of the original river bed.

There are 23 gate openings, each 5 feet wide in the clear. The width between abutments of dam is 225 feet. The arrangement of gates is nearly the same as at the Truckee dam. They are of cast iron, with cast-iron guides. The lower gate is 5½ by 5 feet, 1⅛ inches over all. The body is three-fourth-inch thick, and is reenforced by vertical and horizontal ribs spaced 1 foot apart. These ribs are three-quarter inch thick by 4 inches deep, and are on the upstream side. The body is bowed downstreamwards sufficiently to allow these ribs to clear the back of the upper gate.

SOUTH SIDE DISTRIBUTING CANALS.

The south side distributing canals constitute the main canal system and reaches the area south of the main river and of the most northerly branch of the river, the latter being called "Old River." At a point about 7 miles below the diversion dam, South Branch of the river splits off and flows southeast, and at about 3 miles farther on the river again divides into Old River and New River. The former turns to the northeast. The main canal and branches cross both South Branch and New River, and reach the territory as far north as Old River. The main canal has been built a distance of 21.69 miles, while its principal branch has been built 5.28 miles.

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[a] See Third Ann. Rept. Reclamation Service, Pl. XXXIX.

The main canal is gradually reduced in size. For the first 6 miles over one-third of the line is in curvature; for the remainder the curves cover not over 15 or 20 per cent of the length. The curves range all the way from 1° to 15°. The country is open, though broken in places by sand dunes and ridges. The canal follows the general slope of the country to the east and southeast, which requires occasional drops or falls in the grade.

For several miles both above and below the dam there is a broad bar or ridge on the south side of the river, in places bordering the channel, but usually one-fourth to one-half mile back. Crossing over this the ground slopes away to the south. To the southeast of the dam there occurs a depression or saddle in this ridge 30 or 40 feet lower than adjacent parts. It was desirable that the canal be carried through this ridge as immediately as possible, to reach land south of this locality, and also to avoid the high banks along the river in places.

At 10.1 miles from the head the canal bifurcates. An elaborate construction is required for the division and regulation, combined as it is with a fall in each branch. Rising weirs of unusual length are also used.

NORTH SIDE DISTRIBUTING CANAL.

This canal is diverted at the north end of Carson dam, and serves the country north of the river and northwest of Old River branch. The line runs east and northeast, swinging around the north side of Soda Lake (where some soda works are operated on an extensive scale), and splitting into several branches about 1 mile northeast of the lake.

LATERAL DISTRIBUTION SYSTEM.

The lateral system is for the subdivision and conveyance of the water in the main distributing canals to the land to be irrigated, including, in most cases, the delivery at the higher side of each farm unit. The irrigable lands in Carson Sink Valley have been divided into 7 divisions or districts (Pl. LIV), each containing 20,000 to 50,000 acres. Each district will have a system of lateral distributaries and necessary waste ditches or drains. The work has been done partly by contract and partly by force account. It was started in November, 1904, and is still under way. The lands in districts 1 and 2 have so far been more fully supplied with laterals than in any of the other districts.

From the main distributing canals are taken off the larger or primary laterals, from these the secondary laterals, and from these in turn the tertiary laterals, which latter form the final subdivision and supply the individual farm units. This is the general arrangement, but there are variations. In many cases farm units are supplied directly from secondary laterals, and in some cases from primary—usually only where the latter are much reduced in size.

The usual arrangement can be compared to a tree, the primary forming the trunk, the secondaries the main limbs, and the tertiaries the smaller branches of these. Like the trunk, the primary reduces in size toward the end until it becomes a secondary, or branches into two or more of the latter, which in turn end in tertiaries. The secondaries also reduce in size toward the ends, similarly to the limbs.

The country reached is open, most of it nearly flat, and the general drainage is southeasterly in districts 1 and 3, northeasterly in districts 2, 4, and 5, northwesterly in district 6, and northerly and easterly in district 7. The latter is supplied directly by laterals from the main Truckee Canal.

As far as possible, all the laterals follow the higher ground, the primaries being located to follow the larger watershed lines and the others the subdivisions of a general watershed. In most cases these lines, owing to the flatness of the country, are not well defined, and it required some preliminary surveys as well as use of the topographic maps (which showed 5-foot contours) to determine the best location.

Where the country is fairly uniform, most of the ditches follow the land lines of the sectional subdivisions. In other localities, particularly for the laterals so far built under the north-side main canal, situated in district No. 2 (old P, N, Q, U, X and R districts), this is impracticable. In the former case the secondaries and tertiaries are usually located along the highest side of the land subdivisions, by which the direct turning out of the water onto the lands is much facilitated.

In connection with the laterals a system of drains was provided. These are to take care of seepage and drainage and waste waters in general, including any surplus in the ditches that it may be desired to dispose of.

The advisability of drainage in connection with irrigation, particularly in a country like this (with comparatively little slope and in places a clay subsoil), is apparent. To one who has seen large areas of good land practically ruined by excessive irrigation and the entire lack of a drainage system, as has happened in numerous localities with the slipshod and wasteful methods so commonly used, the drainage feature is appreciated.

Where the land lines can not be followed by the irrigation laterals, the drains follow the natural drainage lines, which are at the bottom of the depressions. They are intermediate between the laterals, the latter following the raised portions, which form what might be called very low ridges. The relation of the different parts of a system of drains is similar to that of the laterals, but with the flow reversed. The main drains south of the river discharge into Carson Lake for the present, or into one of the river branches or sloughs, while those for the north-side system empty into Carson River, or Old River Branch.

Where the laterals follow the land lines, the drains parallel them. The ditches are usually one-half mile apart, following the section and quarter-section lines. The laterals follow the upper side of the subdivisions and the drains the lower side, so that the lateral for one subdivision is paralleled just across the line (usually taken by a road) by a drain for the opposite piece of land. In district No. 1 the drains come north or west of the laterals.

The laterals are built so as to have normally part of the water section above the natural surface of the ground. With the drains the opposite condition is desired, and they are excavated much deeper. In them the side slopes forming the water section are 1½ to 1, while they are 2 to 1 in the laterals.

The sizes and grades of nearly all of the larger laterals are adjusted to give a calculated velocity below 2 feet per second. The average velocity for the smaller laterals is about 1.6 feet. There is a great variety of sizes, but the following include most of the standard sections:

Standard sections of laterals, Truckee-Carson project.

Base.	Water depth.	Area water section.	Embankment.		Grade.	Velocity.	Discharge.
			Height.	Top width.			
Feet.	*Feet.*	*Square feet.*	*Feet.*	*Feet.*		*Feet per second.*	*Second-feet.*
8	3.5	52.5	5.0	4	0.0004	1.98	104.0
6	3.5	45.5	5.0	4	.0004	1.90	86.0
6	3.0	36.0	4.5	4	.0005	1.94	70.0
5	3.0	33.0	4.5	4	.0005	1.89	62.4
5	2.5	25.0	4.0	4	.0006	1.84	46.0
4	2.8	26.9	4.0	4	.0007	2.09	56.3
4	2.5	22.5	4.0	4	.0006	1.79	40.3
4	2.5	22.5	3.5	3	.0006	1.79	40.3
3	1.5	9.0	3.0	3	.0010	1.65	14.8

Side slopes next to water are 2 to 1; outside slopes of embankments, 1½ to 1 and 2 to 1. Value of "n" taken as .025 in above table. For the more recent work on the system the value of "n" has been assumed as .020.

All the lines, even for the very smallest laterals, are staked out with the transit, regular curves being run in.

The structures used where the smaller laterals branch off from the larger ones are termed "turn-outs." There are several types used, based mainly on the size, material, and whether used with drops. The turn-outs in the larger laterals are of concrete and in the smaller ones of wood. A lateral capacity of about 30 second-feet is usually the dividing line between the two different materials.

As the general slope of the country is too great for continuous ditch grades, occasional falls or drops are put in and in many cases the turn-outs are combined with falls, thus reducing the number of structures. This is the case with practically all the concrete turn-outs. Nearly all these structures can be referred to two general types, simple turn-outs and those combined with drops. A representative type of each will be described.

The simple turn-out consists of two parts, the stop gate in the main lateral and the diversion gate placed in the bank at right angles to and cornering with the stop gate. The supporting structure for each gate is confined to its immediate plane, simply consisting of framework for the gate opening, with wing walls and foot-wall carried well into the earth sides and bottom. Four by six posts, one each side of the opening and two or more outside of this, are planted about 2½ feet below ditch grade, and the upstream and downstream sides are each covered with a double thickness of 1-inch plank, lapped to break joints. The bulkhead or wall thus formed is all of practically one section, but the ends, which are run well back into the banks, are not carried so deep in some cases.

The gate openings are regulated with 2 by 8 inch plain flashboards, having 1½-inch bearing in the plain wooden guides. They rest on a 2 by 6 sill, and back of the contact is placed a 2 by 4 strip to more effectually cut off any leakage over the sill. This is placed flush with the ditch bed.

The diversion gate is buried in the bank at its inner edge. The double planking on the back of the framework is carried past the junction with the stop gate, to give a longer cut-off below the latter. The sloping part of the ditch bank in front of the branch lateral is cut down and rounded off, so as to give a good entry to each lateral.

With these small and simple structures, as well as with larger ones used on the project, the rule is followed to pave the bed and sides of the ditches for a few feet below.

The turn-out combined with drop is more complicated, occupying some space longitudinally on each lateral. In each one the gate is rectangular in plan, with flaring wing walls at the lower end and with square wing walls at the upper end carried most of the way through the banks. The posts are 6 by 6 feet and are carried to a depth varying with the distance from the center.

The sides and wings are planked with a double thickness of 1-inch plank, placed outside (farthest from stream) of the posts, by which arrangement the pressure of the earth filling behind can not force off the planks. Where over a certain size, a thickness of 2-inch plank is substituted for one of the 1-inch layers over lower part of the walls. At lower end of floor of the gate a stop plank is placed to make a water cushion, the depth depending on the drop.

The position of the square wing walls at the upper end of each gate and the curved approaches are similar to those of the simple type, except that one side of the diversion gate is directly formed by continuation of the adjoining square wing wall of the stop gate.

CARSON RIVER OLD CHANNEL IMPROVEMENT.

The plan to run all the surplus water of the Carson into its Old River branch has already been noted. The idea is to close up the other divisions—New River and South Branch—entirely, so as to rid the flat country south of the river of the waters and to prevent their reaching Carson Lake. Both the lake and the country farther north are to be drained, and to decrease the volume of drainage it is desired that no more water reach this locality than necessary. The Old River branch is being improved so as to carry all the surplus waters coming down the main river and discharge them into Carson Sink, which is the lowest part of the valley.

The natural channel is extremely winding and it is also of comparatively small size, so that much work in straightening and widening is required to fit it for taking the entire river discharge. The work has been done partly by contract and partly by force account.

DUTY OF WATER.

With the completion of the first unit water will be available for 200,000 acres in Carson Sink Valley, of which it is estimated that only 80 per cent need be covered during any one season. For several years the duty of water will not be of much importance. When the land is all irrigated a duty based on 2 to 3 acre-feet per acre will be required. With 150,000 acre-feet available supply from Lake Tahoe in addition to the normal flow of the two rivers, it is estimated that 160,000 acres net can be irrigated, except during unusually dry seasons, when probably 80 per cent of this acreage can be covered to the usual depth. The streams do not usually become very low until a large part of the crops, such as grain, are harvested. Irrigation in this region begins as early as March and continues until September, but only late crops of alfalfa, potatoes, etc., are watered during the latter month. The water from Lake Tahoe will be used mainly for late irrigation, including probably one irrigation for all the crops. The normal flow of the rivers is sufficient until well into the summer.

TELEPHONE CONSTRUCTION.

An almost essential aid to operation of the canal and reservoir system is the telephone system, built and owned by the United States. The construction work has all been done by force account. A fully-organized force has been engaged in the work, which started at the end of 1904, and is still underway. A total of 84 miles of line has been built up to June 30, 1906, and a start made on other lines with an additional length of 50 miles.

WORK IN PROGRESS.

Since November 1, 1905, the location of lateral canals and drain ditches has been finished in districts Nos. 3, 4, and 5, also for a part of district No. 7. As construction of these canals progresses it will probably be found necessary to revise portions of the original location. The topographic surveys of irrigable land embraced in this project have been completed. Mapping of all irrigated lands in the Humboldt River Valley above Lovelock, begun in the latter part of 1905, was discontinued during the winter of 1905–6.

No contract work has been undertaken since the date of the last annual report, but force account work has been carried on on the lateral canal system. In district No. 1, drops, turn-outs, bridges, and culverts of concrete and timber have been completed in D and E subdistricts. This work includes 6 concrete drops and turn-outs, 159 timber drops and turn-outs, 3 pipe culverts, 63 timber culverts, and 17 timber bridges. In district No. 2, 1 tertiary lateral 1,500 feet in length has been excavated. In district No. 3, 85.82 miles of lateral irrigation ditches and 7.47 miles drain ditches have been excavated. No structures have yet been built in this district. In district No. 4, 3.28 miles of laterals have been excavated. In district No. 5 construction of a portion of the lateral system was begun about June 20, and 0.60 mile of ditch completed by June 30, 1906. No work has been done in District No. 6. In district No. 7, 21 miles of laterals were completed. Seven turn-outs from the main Truckee Canal were started, and 3 completed before June 30.

Bid opened April 19, 1906, for the construction of lateral ditches with structures, District No. 3, Truckee-Carson project.

[Specifications No. 80.]

Work.	Amount.	Unit price.	Clement & Strange, 307 Dooly Block, Salt Lake City, Utah. Amount.
Excavation:			
Class 1 ..... cubic yards..	600,000	$0.21	$126,000.00
Class 2 ..... do....	5,000	.50	2,500.00
Overhaul ..... do....	50,000	.015	750.00
250 turn outs:			
Concrete ..... do....	1,300	17.50	22,750.00
Cast iron ..... pounds..	10,200	.07	714.00
Steel rods ..... do....	6,500	.09	585.00
Flashboards with hooks	50	1.70	85.00
Redwood lumber ..... feet B. M..	225,000	[a]85.00	19,125.00
Back filling ..... cubic yards..	2,000	.70	1,400.00
Paving ..... square yards..	9,000	6.00	54,000.00
Paving (grouted) ..... do....	500	7.00	3,500.00
Puddling ..... do....	2,600	1.00	2,600.00
42 bridges:			
Clear Oregon pine lumber in place ..... feet B. M..	35,000	[a]60.00	2,100.00
Oregon pine lumber in place ..... do....	80,000	[a]60.00	4,800.00
Concrete culverts and flumes ..... cubic yards..	100	17.50	1,750.00
R. W. and O. P. lumber in place ..... feet B. M..	36,000	[a]75.00	2,700.00
Pipe drains, hauling and laying 15-inch sewer pipe ..... do....	775	.60	465.00
Concrete foot walks ..... cubic yards..	30	17.50	525.00
Steel I-beams ..... pounds..	1,200	.08	96.00
Total bid	.....	.....	246,445.00

[a] M feet B. M.

On May 12, 1906, the bid of Clement & Strange for this work was rejected by the Secretary of the Interior and authority was given to carry it on by force account. Necessary equipment is being assembled, and steps are being taken to purchase 160 head of mules. It is anticipated that the actual construction will be started about September 15, if laborers can be procured for it.

MAINTENANCE AND OPERATION.

During the season of 1905 water was supplied from the Government canal system to a limited area of land previously under cultivation, but the system can not be said to have been put in operation until the season of 1906.

Heavy snowfall in the mountains during the winter gave every promise of a good year in 1906, and the season so far has been one of the most successful ever experienced by the settlers. The amount of water in the river was ample for irrigation until about August 15, and then Truckee water was introduced into Carson Sink Valley for irrigation purposes for the first time. On February 5, 1906, water was turned into the main canals from Carson River. Only a small amount of water was delivered for irrigation until April first. The time during February and March was devoted to priming and testing canals preparatory to delivery of water. Early in April the following notice was sent to all homesteaders to whom water could be delivered in April.

> You are hereby notified that canals and ditches are now ready for delivery of water to farm unit ——— filed upon by yourself.
>
> You should notify this office when you desire water for irrigation.
>
> Water right payment of $2.60 per acre of irrigable land will be due on this farm unit December 1, 1906.

At the same time the following simple regulations were approved and published in the county papers, and mimeographed copies were prepared for distribution by ditch riders.

1. Water is now running in the canals of the Truckee-Carson project, and on April 1 the regular irrigation season will open. Water will be supplied to all farms entitled to receive water on and after that date, if gates, ditches, and waste canals are ready for the proper handling of the water.

2. Farmers who desire water should notify the engineer in charge of the maintenance and operation of the system, or his duly authorized ditch tenders, by telephone, mail, or in person, at least twenty-four hours before water is needed, stating the amount of water and the length of run desired. Notice will in return be given of the time water will be turned on and the amount of head.

3. When water is to be turned off, notice should be given to the ditch tender or the office at Fallon at least twenty-four hours before the end of the run. Unless such notice is given, water will be turned off at the time stated in the original request for water.

4. No one but the ditch tender shall operate any gate or turn-out on the project. All gates will be locked as soon as possible to prevent any unauthorized person from raising or lowering them.

5. Water entering any farm must be cared for by the owner or tenant throughout the period of the run. The head must not be lowered at night. Farmers are expected to care for water day and night. The drainage ditches are not to be used as waste ditches except in case of emergency. Waste water should be cared for on the farm and if waste water in any quantity runs off the place it will be taken as good evidence that the head is too great and the amount of water turned into the farm will be lessened accordingly. Any damage made by waste water entering drains must be repaired immediately by the persons responsible for the damage. Failure to attend to damage of this sort will result in water being refused the place until such damage is repaired.

6. Farmers and all others will confer a great benefit to the project if they will attempt to stop all breaks caused by weeds or obstructions in ditches. Breaks should be reported to the office or ditch tender at once if possible, but many times it will be less work to make a temporary stoppage of the leak. Maintenance of all lateral canals will be eventually turned over to the farmers.

7. All canals, laterals, and ditches are the property of the Government of the United States and should be respected accordingly. Cattle should not be allowed to water in ditches or drains. Bridges have been provided at convenient places, and canals or drains should be crossed only at such points. No bridges, culverts, boxes, fences, or other structure should be built across any canal, lateral, or drain without written permission of the engineer in charge of maintenance and operation.

8. Where gardens are being cared for, special arrangements may be made for a garden head or small flow of water for irrigation of gardens more frequently than the ordinary land.

9. Complaints of irregularity of service or of inattention on part of ditch tenders should be made in writing to the engineer in charge at Fallon. Ditch tenders have no power to change instructions issued them and any dissatisfaction caused by their acts should be reported to the office for correction.

After the opening of the canal system on February 5, the water in the canals was gradually increased until the amount needed for the proper distribution was reached. The maximum amount carried reached 460 cubic feet per second in the main canal diverting from the south side of Carson River. The main Lower Truckee canal carried a very small head during the period when Carson River was high, but when in August the Carson fell below the needs of the system the amount diverted from the Truckee was increased until a maximum of 200 second-feet were delivered into the Carson.

A heavy flood passed down Carson River about the middle of January, following the coldest weather of the season. At the time the flood came down the quiet parts of the stream were covered with ice 6 to 12 inches thick. This ice broke up, partly melted, and the flood passed the diverting dam without being noticeable. As this is the thickest ice ordinarily had in this region, the ease with which this flood and ice were handled promises well for the future management of this structure. Similar experiences were had at the Truckee dam. Here unusually cold weather with its accompanying ice was passed without difficulty.

Although the heaviest snowfall in years was reported from the headwaters of Truckee and Carson rivers, no heavy floods came down until May 12, when a maximum of 3,300 second-feet passed the gaging station at Empire. The river then dropped to less than 2,000 second-feet. The maximum discharge reached was about 4,000 second-feet on June 20. This is the first heavy flood which has passed since the completion of the main canals across the two branches of Carson River—South Fork and New River. The corrected and enlarged bed of Old River carried this heavy flood with a minimum of damage in spite of the fact that the work is not completed. All the old obstructions and dams which heretofore have caused the spring floods of the Carson to spread over the bottoms and do serious damage have been removed, and thus it is possible for a heavy flood to pass without damage.

The canals of the project have been successfully operated without serious mishap. The length of lines operated is as follows:

Lengths of canal lines operated, Truckee-Carson project.

	Miles.
Main canals	67.2
Primary laterals	33.7
Secondary laterals	17.5
Tertiary laterals	45.7
Total	164.1
Drains	44.4

The cost of maintenance and operation has been as follows:

Approximate cost of maintenance and operation, Truckee-Carson project, January to July, 1906, inclusive.

	Maintenance.	Operation.
January	$1,133.35	$174.00
February	600.51	598.37
March	2,407.57	892.25
April	4,690.51	900.83
May	3,967.61	1,114.83
June	3,357.21	1,106.30
July	2,725.75	1,209.92
Total	18,882.51	6,056.50 18,882.51
Grand total		24,939.01

The principal items of cost in this sum have been as follows:

Distribution of cost of maintenance and operation, Truckee-Carson project.

Item.		Quantity.	Total amount.	Cost of maintenance per unit.
Brush to prevent washing of banks	linear foot	30,000	$4,324	$0.144
Repair	square yards	25,000	1,627	.065
Earthwork	miles ditch	208	9,641	46.30
Timber structure [a]	structure	312	793	2.54
Concrete structures	do	70	2,496	3.56
Operation	acre-feet	100,000	6,056	.061

[a] Not including 177 bridges and culverts.

These figures are approximate only, as certain expenses are charged to general maintenance and can only be distributed at the end of the year.

In some of the soils through which the canals run it is exceedingly difficult to prevent washing. Alkali in the subsoil rises in the ditch banks and wherever water touches the alkali soil the bank caves in. To prevent this going too far brush is used as temporary riprap. This has formed an important item in the expense bill. When the banks become settled and are washed free from alkali this trouble will cease, and it is expected that the expenses for work of this sort will become less each month.

One of the most costly items of expense is in maintenance of the earthwork of canals and laterals. In places where ditches and laterals run through old fields much trouble has been caused by gophers, squirrels, and other burrowing animals. Systematic efforts are now being made to rid the canal banks of these pests.

Maintenance costs for the year 1906 will be larger than any year to follow so far as present information goes. As the canal banks become settled trouble will be less.

Records are kept of the amount of water delivered to each farm. Each ditch rider is supplied with cards on which he records all changes in amounts of water in laterals and notes the quantity of water delivered. From these data it is possible in the office to keep a ledger account of amount of water furnished each farm.

On the routes of each ditch rider there are a number of principal points, as at heads of principal laterals, at points in main canal, and at main drains, where the amount of water in the canals is measured. Each rider carries "Water Passing Gage" cards on which he records gage heights each day of the month.

The operation of a canal system of this magnitude presents a most excellent opportunity to determine the hydraulic constants of the works upon completion. In order, therefore, to gather data which will enable further extensions of the project to most thoroughly meet the requirements, two men have been engaged during the summer months on hydrographic investigations.

Among other work measurements have been made of the losses by seepage and evaporation from the canals. The following table shows the amount of this loss:

Losses from seepage, Truckee-Carson project.

Canal.	Length section measured.	Amount Flowing.	Loss in distance.		Per cent per mile.
			Second-feet.	Per cent.	
		Second-feet.			
V Line:					
Carson dam to station 483	48,500 feet, or 9.2 miles	423.00	28.20	6.7	0.73
Station 597 to station 750	15,300 feet, or 2.9 miles	247.00	3.10	1.25	.43
Station 750 to station 1204	45,400 feet, or 8.6 miles	191.00	12.30	6.5	.756
Entire line	20.8 miles	423.00	43.70	10.3	.49
T. Line:					
Stations 221 to 476	4.8 miles	24.10	3.19	13.2	2.75
U line	10.2 miles	25 20	9.07	36	3.5
Lb line	3.9 miles	36.80	4.07	11	2.80
Ld line	4.56 miles	20.40	4.92	24.1	5.28
Le line	3 miles	19.10	2.30	12	4

The settlement of the lands is going on slowly. On April 1 canals were ready to deliver water to 35,000 acres. On July 1, 40,000 acres could be watered. A census taken during May showed 34 new settlers being supplied with water, and water was being carried through the canals and delivered to 53 old settlers. The area of old and new farms and pasture lands being watered is over 20,000 acres of land.

There is every indication of great fertility of the soils being farmed. Where the settlers have remained on their places and pursued their business of farming with diligence and intelligence very encouraging results have been obtained.

IRRIGABLE LANDS.

The approximate distribution of the irrigable lands is shown in the following table:

Lands included in the Truckee-Carson project.

	Acres.	Percentages.
GENERAL.		
Total	301,000	....
Private	78,400	26
Public	222,600	74
Irrigated	12,950	4
Irrigable	231,300	77
Nonirrigable	69,700	23
PRIVATE.		
Total	78,400	....
Irrigated	12,950	26
Irrigable	74,400	95
Nonirrigable	4,000	5
PUBLIC.		
Total	222,600	....
Irrigable	156,900	70
Nonirrigable	65,700	30
IRRIGATED.		
Total	12,950	....
In Storey County	150	1
In Lyon County	....	....
In Churchill County	12,800	99
In district 1	4,300	33
In district 2	900	7
Id district 3	4,000	31
In district 4	800	6
In district 5	2,300	18
In district 6	300	2
In district 7	350	3
IRRIGABLE.		
Total	222,600	....
In Storey County	300	....
In Lyon County	9,000	4
In Churchill County	213,300	96
In district 1	24,700	12
In district 2	33,600	15
In district 3	65,000	28
In district 4	45,000	19
In district 5	33,000	14
In district 6	10,000	4
In district 7	20,000	8
IRRIGABLE—continued.		
Under gravity system	215,900	93
Requiring pumping	15,400	7
NONIRRIGABLE.		
Total	69,700	....
Public	65,700	94
Private	4,000	6
In Storey County	1,500	2
In Lyon County	1,500	2
In Churchill County	66,700	96
In district 1	1,300	2
In district 2	16,400	24
In district 3	15,000	21
In district 4	20,000	29
In district 5	2,000	3
In district 6	5,000	7
In district 7	10,000	14
IN STOREY COUNTY.		
Total	1,800	....
Private	1,400	78
Public	400	22
Irrigated	150	8
Irrigable	300	17
Nonirrigable	1,500	83
IN LYON COUNTY.		
Total	10,000	....
Private	5,000	50
Public	5,000	50
Irrigated	....	....
Irrigable	9,000	90
Nonirrigable	1,000	10
IN CHURCHILL COUNTY.		
Total	280,200	....
Private	72,000	25
Public	217,200	75
Irrigated	12,800	4
Irrigable	222,000	77
Nonirrigable	67,200	23

EXPENDITURES.

The expenditures on the Truckee-Carson project are summarized in the following tables:

Expenditures, according to physical features, on Truckee-Carson project, to June 30, 1906.

Features.	Engineering and administration.	Building.
Incidental structures:		
Telephone line, 84 miles	$1,990.81	$19,623.27
Offices, cottages, lodging and boarding houses, warehouses, etc	1,087.82	13,756.47
Irrigation structures:		
Lake Tahoe regulating works	1,757.48	11,429.62
Truckee diversion dam	3,832.34	82,557.91
Truckee canal and structures	89,177.30	1,315,568.88
Carson diversion dam	4,266.88	81,671.92
Lower Carson reservoir	7,380.43	36,839.69
Alkali Flat reservoir	6,972.53	7,969.30
Main distributing canals and structures	35,817.86	405,842.13
Laterals and drainage system	76,963.15	575,239.39
Maintenance of irrigation works	19,587.84	....
Operation of irrigation works	12,029.35	....
Farm unit subdivision and soil examination	31,269.09	....
Examination of project as a whole, including topographic surveys	106,320 59	....
Administration of project as a whole	163,484.10	....
Total	561,937.57	2,550,498.58
Grand total	....	3,112,436.15

Expenditures, according to purpose and nature, on Truckee-Carson project, to June 30, 1906.

[Total, $3,112,436.15.]

	Services.	Traveling.	Subsistence.	Equipment.	Materials.	Supplies.	Rent and storage.	Forage.	Job work.
Engineering:									
Examination	$13,728.55	$949.97	$1,455.80	$1,396.21	....	$2,869.95	$157.54	$446.05	....
Survey and inspection	159,381.05	8,420.07	18,950.92	14,013 02	$105.64	36,099 68	1,169.36	9,962.06	....
Design	36,105 35	2,294.26	2,834.90	3,201.38	28.21	8,639.60	286 10	972 92	....
Subdivision	15,281.17	920.53	888.56	1,374.46	2.88	2,665.09	157.54	271.65	....
Building:									
Rights and property	1,224.52	108.15	70.30	....	8,457.00	14,534.93	....	....	....
Building	251,966.00	3,713.35	44,856.15	8,855.08	148,302.83	25,322.47	228.79	62,848.27	$1,987,291.01
Operation.									
Maintenance	10,568.38	4.65	1,076.13	579.72	84.73	533.46	....	1,019.22	....
Operation	8,272 38	28 97	44.20	569.24	151.61	85.03	....	17.14	....
Administration	123,990.27	9,178.26	8,195.50	14,560.92	281.16	24,360.62	1,642.30	4,382.94	....

PROPOSED WALKER RIVER PROJECT.

The area included in the proposed Walker River project embraces the basin of Walker River in eastern California and western Nevada, where is a large tract of arable land within reach of an easily controlled water supply. Walker River, which furnishes the water supply, is formed by the junction of East and West Walker rivers, near the south end of Mason Valley, Lyon County, Nev. Each of these tributaries has its source and obtains most of its water on the eastern slope of the Sierra Nevada in California south of the Truckee and Carson river watersheds. They flow in a general northerly direction and unite in Nevada. From this point the main stream flows north for nearly 20 miles, then southeast, and finally empties into Walker Lake, where its waters are lost by evaporation.

The principal bodies of irrigable land are situated in Antelope and

Smith valleys, the former partly in California and partly in Nevada, and the latter entirely in Nevada, on the West Walker; Bridgeport Valley or Big Meadows on the East Walker, in California, and Mason Valley on the Walker in Nevada. In these four valleys and along Walker River and its tributaries are about 150,000 acres of excellent land lying within convenient reach of its waters. Of this total area probably 40,000 acres are now under irrigation, being mainly devoted to alfalfa, native grasses, and other forage crops.

The first measurements of the water supply were begun by the United States Geological Survey in July, 1895, but were discontinued shortly afterwards. Gagings were resumed, however, in 1901, and have been continuous since that time near Coleville, at the head of Antelope Valley on the West Walker; at the point where the East Walker enters Mason Valley and near Wabuska on Walker River in the northern part of Mason Valley. The data provided by these measurements have not been carefully worked up as yet for the purpose of determining the available water supply for irrigation, but it is known that much of the flood waters that now go to waste can be conserved by means of storage reservoirs, and made use of during the irrigation season.

In 1902 a general reconnaissance of the Walker River basin was begun for the purpose of collecting data to form a basis for outlining an irrigation project. During this season reservoir sites were surveyed as follows: Leavitt Meadows near the head of West Walker, and Twin Lakes and Big Meadows on the East Walker. Preliminary surveys were also made for two canals—one on each side of the river in each of the principal valleys, except Bridgeport Valley.

During the winter of 1904 and 1905, at the instance of farmers in the valleys of Walker River, who are involved in litigation over their water rights on account of the insufficiency of the supply for irrigation in the latter part of the season, an investigation was made to determine the feasibility of storing enough of the flood waters to provide an ample supply to all lands now under cultivation and irrigation. A reservoir site was carefully examined and it was found that water could be stored at reasonable cost, but the landowners have failed to organize a water-users' association or to take other necessary steps to comply with the terms of the reclamation act. In the meantime, two other reservoir sites have been examined, and in cooperation with the State engineer nearly all of the irrigated and irrigable lands have been surveyed and mapped on a scale of 1,320 feet to the inch, with contour interval of 5 feet. These surveys were practically finished in December, 1905, and no field work, except stream gagings, has been done on the project since.

The expenditures on the proposed Walker River project are summarized in the following tables:

Expenditures, according to purpose and nature, on proposed Walker River project to June 30, 1906.

[Total, $12,220.29.]

	Services.	Traveling.	Subsistence.	Equipment.	Supplies.	Forage.
Engineering:						
Examination	....	$2.75	....	$212.43	$11.75	....
Survey	$8,344.06	47.10	$2,025.06	21.28	511.76	$1,044.10

NEW MEXICO.

CARLSBAD PROJECT.

GENERAL FEATURES.

The principal data relating to the Carlsbad project are summarized below:

Summary of principal data relating to Carlsbad project.

County: Eddy.
Latitude: 32°.
Longitude: 104°.
Townships: 21 S., Rs. 26 and 27 E.; T. 22 S., Rs. 26, 27, and 28 E.; T. 23 S., Rs. 27 and 28 E.; T. 24 S., R. 28 E.
Irrigable area: 20,000 acres.
Watershed area: 22,817 square miles.
Average rainfall: 12 inches.
Average annual run-off (6-year period): 263,000 acre-feet.
Minimum annual run-off: 151,000 acre-feet.
Range of temperature: Maximum, 110°; minimum, 0°.
Average elevation: 3,100 feet.
Principal products: Alfalfa, corn, peaches, grapes, melons, and vegetables.
Nearest railroad: Pecos Valley and Northeastern of Sante Fe System. Connections: Santa Fe, Texas and Pacific, Fort Worth and Denver City, and Rock Island.
Nearest stations: Carlsbad, Avalon, Otis, Florence, and Malaga. Railroad runs through center of irrigable lands.
Principal markets: Carlsbad, Fort Worth, Denver, and Chicago.
Character of soil: Fertile alluvium.
Value of irrigated land: $80 to $150.
Completion of project: Expect to put water in canals for irrigation in March, 1907, but completion of all work will be at least 6 months later.
Kind of headworks: Diversion dam and spillways.
Capacity of storage reservoirs: About 21,000 acre-feet.
Duty of water: 2½ acre-feet per acre.
Dam height: 50 feet.
Dam length: 1,025 feet.
Dam type: Earth and rock fill with core wall.
Length of canals: 42 miles.
Length of laterals: 112 miles.

This project is situated at Carlsbad on Pecos River in Eddy County, 75 miles south of Roswell (Pl. LV). The plant of the Pecos Irrigation Company, which is fully described in the Fourth Annual Report, has been purchased, and rapid progress is now being made toward the completion of a permanent system for furnishing water to 20,000 acres of good land in the valley, about 13,000 acres of which had been in cultivation for years, but were left without water by a serious washout which occurred in October, 1904. This valuable cultivated area, with its orchards, vineyards, and alfalfa fields, was in eminent danger of going back to the desert condition from which it had been reclaimed, and the people appealed to the Reclamation Service for help. The only way in which help could be given was to purchase the wrecked plant of the Pecos Irrigation Company, and to rebuild it into a permanent practical system. With this end in view, surveys and investigations were begun in January, 1905. A consulting board met at

Carlsbad on August 28, 1905, and after a four days' session recommended that $600,000 of the reclamation fund be allotted for the purchase and repair of this system specifying $150,000 as the purchase price, and $450,000 as the amount necessary for construction. These recommendations were approved by the Secretary of the Interior on November 28, 1905. The Pecos Irrigation Company agreed to accept the purchase price named, and submitted an abstract of title for examination. The beginning of work was necessarily delayed until the title could be examined and perfected. Owing to this delay, authority was not received to begin work, or even to place orders for supplies and equipment, until February 24, 1906. Competitive proposals were secured and orders immediately placed for cement, steel sheet piling, and such machinery and supplies as it would be necessary to have on the ground before work could begin, it being the intention of the Government to do all of the work by force account, except the construction of the Avalon dam, and to furnish cement and steel sheet piling for this dam.

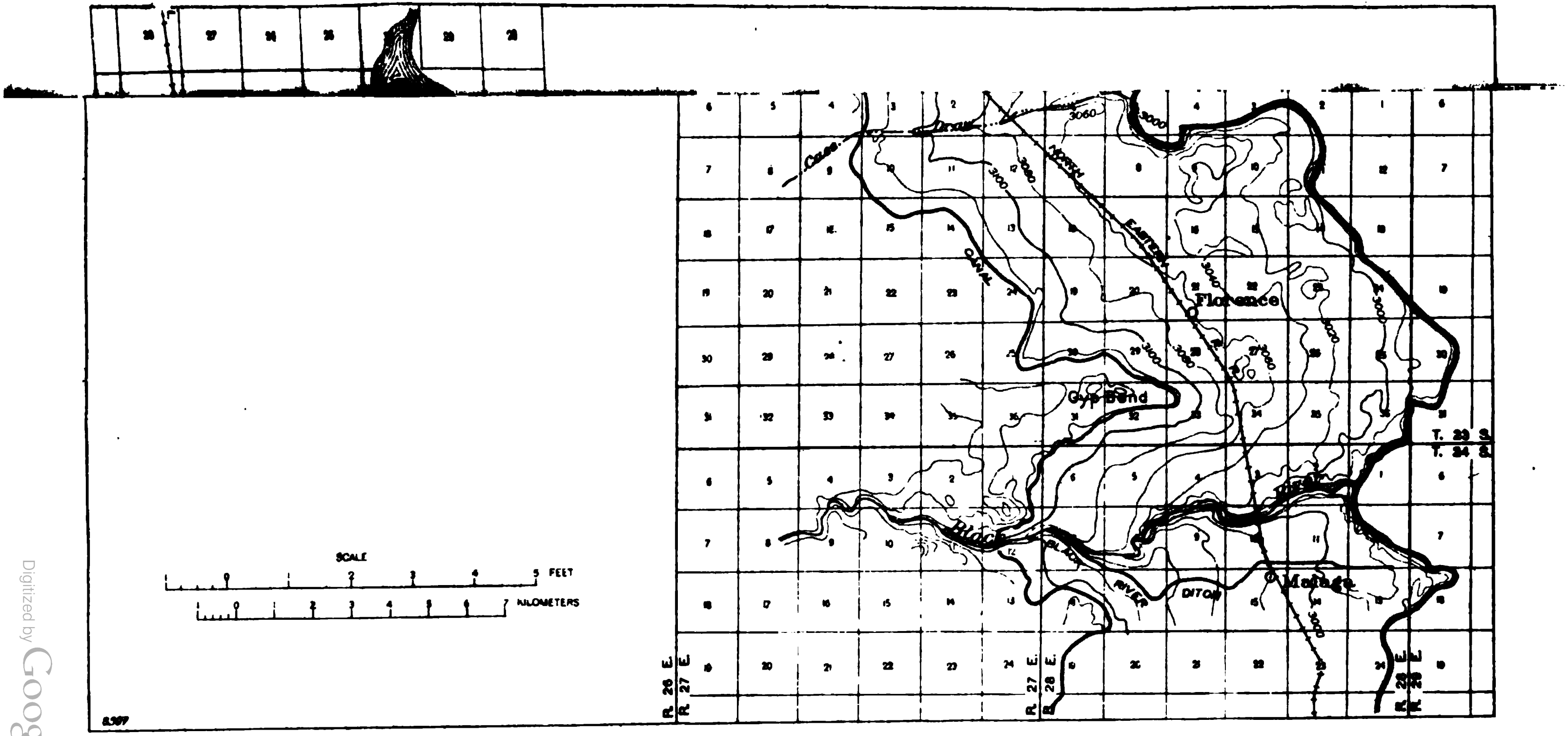
The work necessary on this project consists of making a new gate structure and other improvements at McMillan reservoir, rebuilding Avalon dam as a substantial structure, and making ample spillways; repairing and rebuilding the entire system of canals and laterals; constructing head-gates, storm gates, and lateral gates of concrete and iron for the canal system; repairing the concrete aqueduct across the river; building the concrete steel inverted siphon across Dark Canyon, and reconstructing the Black River canal. The Black River canal forms a separate system and takes water by direct diversion from Black River for the irrigation of about 1,000 acres of the 20,000 under this project.

BLACK RIVER CANAL.

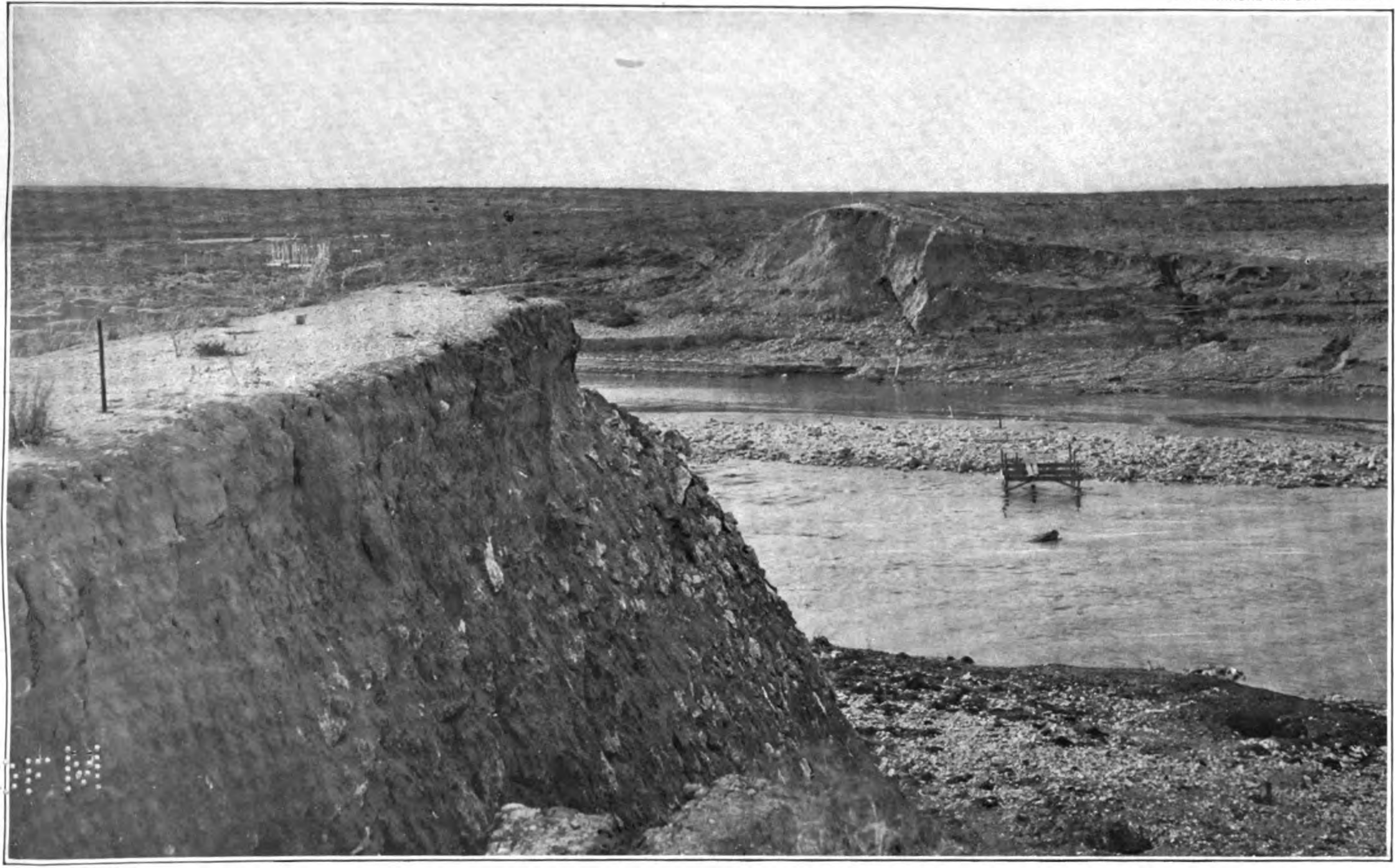
Work was begun on this canal in March, 1906, and was completed on May 22, the water being delivered to the farmers for irrigation on that date. About 6 miles of canal were reconstructed and a concrete lining was placed at the upper end for a length of 4,000 feet. The old canal was so leaky that it delivered only a small percentage of the water that was turned into it from the river. The new canal appears to be absolutely water-tight. It is delivering enough water for the irrigation of 1,000 acres, but only 600 acres are in cultivation this year.

AVALON DAM.

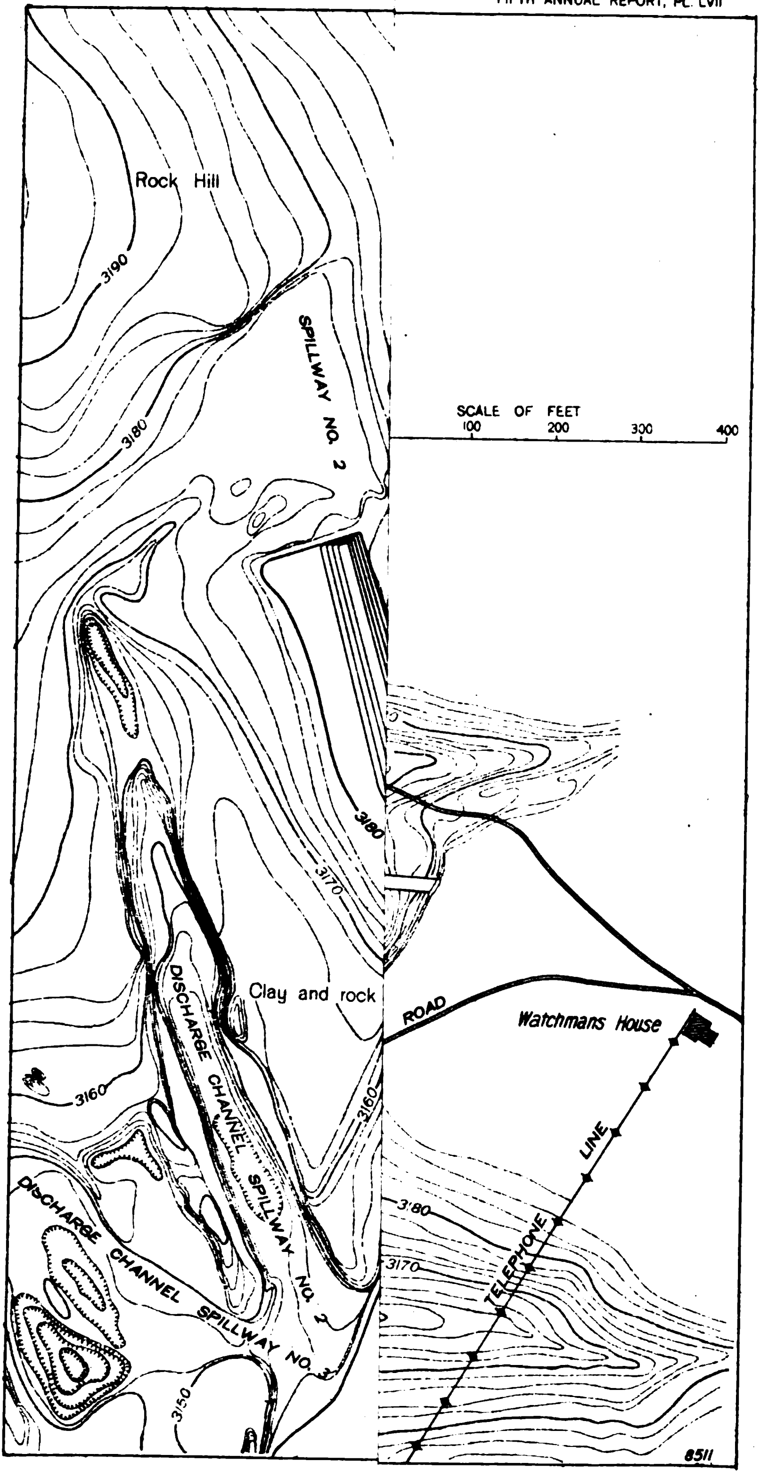
As no bids were received for building the Avalon dam, all the work will be done by force account. This dam is being built across Pecos River at the site of the old dam at the head of the main canal system, 6 miles north of Carlsbad. A portion of the old dam is still standing and will be utilized (Pl. LVI). The new dam (Pls. LVII and LVIII) will be an earth and rock-fill dam, 50 feet high above river bed and 1,030 feet long. For its entire length it will have a core wall founded on bed rock and reaching to the top of the dam. From bed rock to the surface of water in canal, which is 24 feet below dam crest, this core wall is composed partly of rubble concrete and partly of heavy steel interlocking channel barsheet piling, the latter being driven to bed rock in such manner as to form a core wall in that part of the old dam where very deep trenching would be necessary in order to construct a concrete core wall on bed rock. From the top of the steel



GENERAL MAP CARLSBAD PROJECT, NEW MEXICO.



REMAINS OF AVALON DAM, CARLSBAD PROJECT, NEW MEXICO, BUILT BY THE PECOS IRRIGATION COMPANY, AND WASHED OUT BY THE FLOOD OF OCTOBER, 1904.


Rock Hill
3190
3180
SPILLWAY NO. 2
SCALE OF FEET
100
200
300
400
3180
3170
Clay and rock
ROAD
Watchmans House
DISCHARGE CHANNEL SPILLWAY NO. 2
3160
3160
TELEPHONE LINE
3180
3170
DISCHARGE CHANNEL SPILLWAY NO. 3
3150
8511

GENE MEXICO

and concrete core wall just described up to the crest of the dam there will be a vertical diaphragm of reinforced concrete 12 inches thick at its bottom, 8 inches at its top, and 24 feet high. Bed rock is from 10 to 14 feet below the present low-water level of the river. The downstream side of the dam is to be a rock fill and the upstream earth slope is to be well paved with large stone. There are three spillways, two of which are to be considerably enlarged. The machinery, equipment, and supplies for this structure are on the ground. The working force is well organized, and although the work has just begun, it is being pushed rapidly.

MAIN CANAL.

The main canals purchased from the Pecos Irrigation Company had no upper bank, but were "one-bank canals," in which the width of the water surface varied all the way from 50 to 1,000 feet, and had even greater widths in crossing flat ravines. They were also badly out of grade, so that the water in them stood in pools or rushed over shoals. On April 2 a small force was put to work near the head of the main canal, bringing the canal to a uniform width by constructing an upper bank, and to a uniform grade by cutting or filling in the bottom, as the case required. This force was gradually increased to 75 teams. About May 25 another force of an equal number of teams was placed on the main canal near Dark Canyon. When the work was first begun, the plows, scrapers, and other tools ordered had not arrived, and the working force was increased as the tools arrived. On June 30 nearly 5 miles of the canal had been completed, and the work is progressing rapidly. At its upper end the completed section of the main canal is 45 feet wide on the bottom, with side slopes one and a half to one, and is intended for a water depth of 4½ feet. The grade is 1½ feet to the mile.

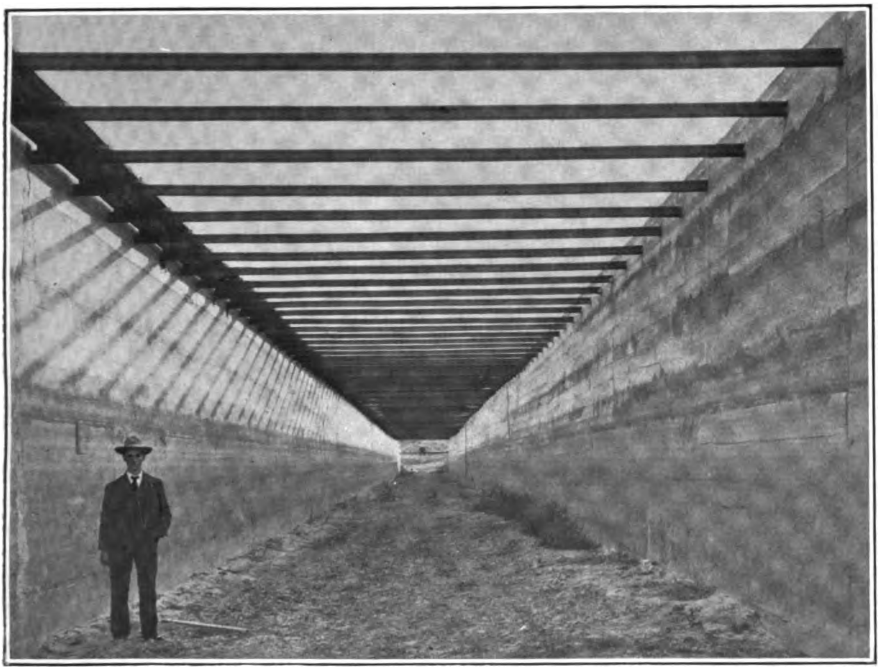
The main canal crosses Pecos River by means of a large concrete structure (Pl. LIX) that is supported on four arches of 100 feet span each. It was badly damaged by the flood of 1904. One of the piers in the river bed was on a very poor foundation, which was washed from under it, causing considerable settlement and cracking. Excavations have been made to a depth of 8 feet under this pier, and it has been underpinned by a wide, heavy foundation of concrete on a grillage of railroad bars. All of the other piers are being strengthened by enlarging their bases, and proper contact will be made between the flume and the earth canal at each end. The cracks and breaks in the flume are also being repaired.

The water in the old canal was carried across Dark Canyon in a large shallow lake that was formed by an earth dam across the lower end of the canyon. About one-fourth of the water carried by the canal was lost by percolation. The canyon being subject to heavy floods, it was necessary to maintain two spillways in the embankment, with an aggregate width of 600 feet. Frequent breaks occurred at one of these spillways. The canal is now double banked and brought to a uniform section at this point, and a gap at the deepest point of the canyon has been left for the storm water to pass through. The canal water is to be conveyed under the canyon in an inverted syphon of reenforced concrete, 6 feet in diameter and 400 feet long. The available pressure head for the inverted syphon will be 2.6 feet, which was obtained by carefully regrading the canal above and concentrating the surplus fall at this point.

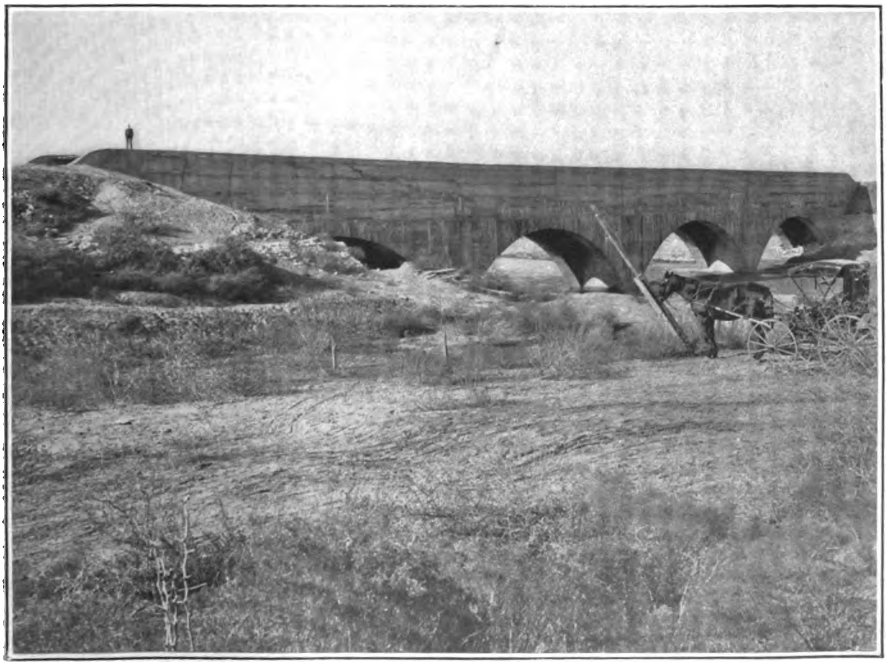
IRRIGABLE LANDS.

The lands to be irrigated by this project have been carefully selected and all the land not considered of good agricultural value has been thrown out. Those owners having valid rights on lands of doubtful agricultural value or absolutely worthless were allowed to transfer their rights to other lands owned by them if duly signed up by the water users' association. In other words, with due regard to vested water rights, it has been the purpose to select the best lands. However, in the case of certain owners in the gypsum districts, usually men with small holdings, but with water rights in good standing, the land has been admitted which otherwise might have been thrown out. Certain lands for which water rights had originally been purchased and for some reason had been allowed to lapse on the Pecos Irrigation and Investment Company's books by reason of nonpayment of yearly rental were next considered. Where land of this class was good and duly signed up it was admitted as water-right land. All first- and second-class lands which lie directly under the system, including certain lands below Black River under the present Black River ditch, belonging to the Pecos Irrigation and Investment Company, have been admitted. No thin and porous land and no doubtful gypsum land have been included in the total acreage admitted. All lands too remote, however good, where extra expense would be entailed by reason of the building and maintenance of long laterals has been excluded. The total area of company land admitted aggregates 5,537 acres. Over much of secs. 12, 13, and 14, T. 23 S., R. 27 E., especially in sections 13 and 14, the water table has been close to the surface, no doubt because of leakage from the canal. The soils over this area are of good quality, are from 2 to 4 feet deep, and underlain by gypsum. By getting below the surface crust of alkali accumulated by evaporation and later by much cultivation, very fine crops of kaffir corn and cotton have been raised in recent years on this soil. This land is agriculturally safe if the canal is made safe and the irrigation water is used sparingly. The worst land admitted is 80 acres in sec. 25, T. 23 S., R. 27 E., which lies immediately under the leaky portion of the canal. The soil here is also sufficiently deep to warrant its admission as agricultural land, but canal leakage must be stopped and good drainage provided. Other second-class land admitted is in portions of secs. 15, 24, 25, and 30, T. 22 S., R. 27. Seepage from over-irrigated lands above has in the past rendered this land unfit for successful farming. More economical use of water above these lands and a few deep drains to the river will render this land especially valuable, because of the depth and excellent quality of the soil. The continued absence of water during the past two years will again allow the farmers to start on well-drained lands. At present surface water is not closer than 20 feet in what was once the worst subirrigated districts.

The last two years have demonstrated to the farmers generally that food crops may be grown with very little water if deep and frequent cultivation is practiced. In cultivated crops much cultivation should be the rule. Discing alfalfa once a year and thus stirring a surface that easily becomes baked and hard, and distributing barnyard manure will increase the yield of this crop. Alfalfa



A. INTERIOR OF CONCRETE FLUME ACROSS PECOS RIVER, BUILT BY THE PECOS IRRIGATION COMPANY, CARLSBAD PROJECT, NEW MEXICO, DECEMBER, 1905.



B. CONCRETE FLUME ACROSS PECOS RIVER, BUILT BY THE PECOS IRRIGATION COMPANY, CARLSBAD PROJECT, NEW MEXICO, DECEMBER, 1906.

fields attacked by root disease, which in the past has been common in this valley, should be plowed and either allowed to lie fallow for a season or planted to some cultivated crop before again reseeding. Cotton is a crop, particularly on the gypsum lands, that must command considerable attention, because of its drought and alkali resisting qualities. Cotton on the farm of J. W. Hayes, below Black River, which has had but one irrigation up to the present time, besides the rainfall of the season, is looking remarkably well. It has, however, been thoroughly cultivated.

Regarding the prospects for commercial fruit growing, the well-drained portions of the valley are particularly well adapted to peach growing. Of the various varieties of fruit trees being grown in the valley, the peach seems to be the healthiest, and the quality of the fruit is unexcelled. With good drainage, deep and frequent cultivation, and careful use of irrigation water, there is no reason why peach growing should not take high rank as a commercial crop on the Carlsbad project. The growing of apples and grapes also deserves more attention. The 20-acre orchard, known as the Cadwell orchard, near Malaga, has a remarkably large crop of very fine apples this year. This orchard is on gypsum land, with soil about 4 feet deep. It, however, lies close to Black River, which position affords good drainage.

That the soils of the valley are deficient in plant food is readily apparent. The matter of fertilization should be studied carefully by the farmers of the valley. Much barnyard manure should be used and green-manuring practiced to a large extent.

It is expected that water will be turned into the canals by March 1, 1907, in sufficient quantity to irrigate all the land that has heretofore been in cultivation. The Avalon dam has been so planned that this can be done before the structure is entirely completed. It is not probable that all of the work on this project will be finished before March 1, 1908.

EXPENDITURES.

The expenditures on the Carlsbad project are summarized in the following tables:

Expenditures, according to physical features, on Carlsbad project to June 30, 1906.

Features.	Engineering and administration.	Building.
Incidental structures:		
Carlsbad office, repairs	$139.53	$331.41
Carlsbad warehouse and corral	138.51	765.46
Avalon dam, roads, bridges, warehouses, etc	213.58	3,789.42
McMillan warehouse	26.38	241.38
Irrigation structures:		
Pecos irrigation system, purchase	197.50	150,000.00
McMillan outlet	160.38	332.76
Avalon dam	247.40	2,013.88
Main and southern canal	1,007.65	12,287.22
Flume, new foundations	106.61	1,015.27
Black River canal	902.07	6,143.99
Inventory	1,149.37	4,786.61
Irrigable lands:		
Farm unit subdivision and soil examination	8,597.19	....
Water Users' Association	3.00	....
Examination of project as a whole	15,726.20	....
Administration project as a whole	6,544.62	....
Total	35,159.99	181,707.40
Grand total	....	216,867.39

Expenditures, according to purpose and nature, on Carlsbad project to June 30, 1906.

[Total, $216,867.39.]

	Services.	Traveling.	Subsistence.	Equipment.	Materials.	Supplies.	Rent and storage.	Forage.	Job work.
Engineering:									
Examination	$8,099.51	$1,555.90	$955.11	$217.44	....	$452.34	$89.71	$220.74	....
Survey and inspection	9,203.72	868.17	2,414.86	1,236.74	$0.50	925.37	17.42	810.74	....
Design	1,177.72	32.54	....	17.92	....	16.21	1.88	....	....
Subdivision	157.78	55.74	57.00	9.42	....	11.51	1.88	....	....
Building:									
Rights and property	176.50	24.20	....	....	....	150,000.00	....	....	....
Building	18,756.23	58.25	498.10	5,888.43	5,018.90	623.97	....	230.99	$431.83
Operation:									
Maintenance	7.50	....	....	....	....	....	....	....	....
Administration	4,751.07	368.20	10.50	498.37	....	697.13	219.35	....	....

HONDO PROJECT.

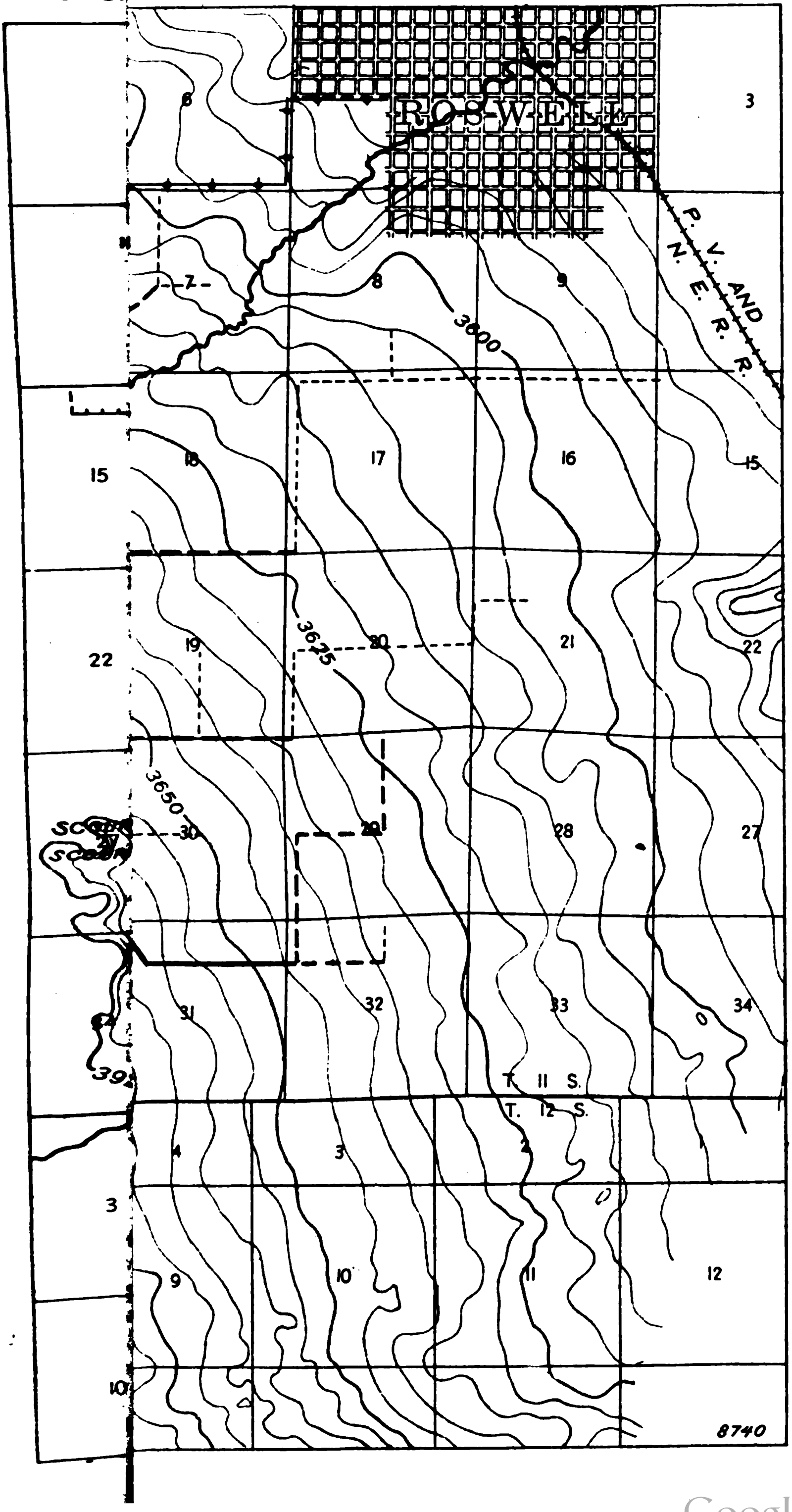
GENERAL STATEMENT.

The principal data relating to the Hondo project (Pl. LX) are given below:

Summary of principal data relating to Hondo project.

County: Chaves.
Latitude: 33°.
Longitude: 104°.
Townships: 10–13 south; ranges 22, 25 east, New Mexico meridian.
Irrigable area: 10,000 acres.
Watershed area: 1,037 square miles.
Average rainfall: 18 inches.
Estimated run-off available for storage: 40,000 acre-feet.
Range of temperature: Maximum, 100°; minimum, 10°.
Average elevation: 3,900 feet.
Principal products: Alfalfa, corn, fruits, and vegetables.
Nearest railroad: Pecos Valley and Northeastern, connecting with Texas and Pacific, Southern Pacific; Chicago, Rock Island and Pacific, and Santa Fe.
Nearest station: Roswell, 12 miles distant from headworks.
Principal markets: Roswell, Amarillo, Fort Worth, and Chicago.
Character of soil: Fertile alluvium.
Value of irrigated land: $80 to $150.
Beginning of surveys: January, 1903.
Kind of headworks: Diversion dam and spillways.
Reservoir area: 1,910 acres.
Reservoir capacity: 40,000 acre-feet.
Duty of water: 2½ acre-feet per acre on land.
Height of diversion dam: 20 feet.
Length of diversion dam: 100 feet.
Dam type: Earth.
Length of canals: 102 miles.
Length of laterals: 20.2 miles.
Power developed: none.
Tunnels: none.

In the following table are listed the contracts entered into for building work on the Hondo project. This list includes all contracts for excavation, embankment, masonry, and erection of structures, but does not include materials such as cement, steel, timber, etc.


ROSWELL
P. V. AND N. E. R. R.
3600
3625
3650
Scoggin
39
T. 11 S.
T. 12 S.
3
6
7
8
9
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18
17
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22
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29
28
27
31
32
33
34
4
3
2
1
3
9
10
11
12
10
8740

Contracts for building work on Hondo project to June 30, 1906.

No.	Contractor.	Feature.	Estimated total value.[a]	Payments to June 30, 1906.	Per cent paid.
26	Taylor-Moore Construction Co.	Dam and canals schedules 1, 3-6.[b]	$118,403	$6,609.14	6
27	Slinkard Construction Co	Dam and canals schedules 2	21,119	26,087.04	100
72	Wood, Bancroft & Doty	Embankments schedules 3, 4	36,908	36,360.50	99
93	T. F. Cazier	Canals and laterals	10,115	8,274.80	82

[a] For a discussion of advance estimates and final costs, see page 51.
[b] Contractor in default. Work carried on by force account.

A general description of the purposes of this work, its location, and the difficulties encountered by reason of the failure of the principal contractors has been given in former annual reports. The entire work, except some of the smaller structures on the distributing system and some puddling in the reservoir, is now completed.

RESERVOIR AND INTAKE CANAL.

The reservoir proper being in a natural depression outside the river channel, it was necessary to convey the water of the river to the reservoir by means of an intake canal. This canal is 8,275 feet in length and has a bottom width of 70 feet at grade line. The bottom of the canal is triangular, as there is a subgrade for facilitating scouring that is 4 feet deeper than the canal grade in the center. The difference between regular canal grade and bank grade is 12 feet. As waters of the Hondo carry much silt, this canal is designed to serve as a settling basin. Therefore there is no embankment upon the upper side and the water is allowed to spread out over a considerable area, so that much of the silt will be deposited before the water enters the reservoir. Some small floods have already passed through the canal and the silt was deposited as was expected. Another test will occur when an attempt is made to move the silt from the settling basins by means of the devices already constructed. These devices consist of two concrete spillways (Pl. LXI, *A*) and four concrete scour gates, the sill of each being set on a level with the subgrade. When the river is in flood these gates will be raised and the silt will be moved as a result of the increased velocity. The water from these spillways and scour gates returns to the natural bed of the river and is carried away from all structures. The spillways were located in rock cuts and needed no other protection; the scour gates were in earth and required lining and riprap for some distance below them. As the river at the diversion point is at nearly the same elevation as the canal, only an earthen dam was necessary to divert the water. A broad spillway is provided above the dam to take all the water above the capacity of the canal. At the lower end of the canal is a reenforced concrete weir 200 feet in length for the purpose of so regulating the flow that only the top one-third will be drawn into the reservoir, the regulating being accomplished by means of flashboards. While the reservoir is situated in a natural basin, it required six embankments (Pl. LXI, *B*, and Pl. LXII) at points on the perimeter to bring the storage capacity to the required amount. These vary in length from 730 feet to 5,468 feet, and in height from 6.8 feet to 25.5 feet. They are 16,504 feet long and contain 526,270 cubic yards of earth.

All the earthen embankments were built in layers, no layer of earth being more than 12 inches in thickness, well moistened and thoroughly rolled and compacted. In order to protect the surfaces against wave action it was necessary to use 81,578 square yards of riprap, consisting of limestone blocks from 12 to 14 inches in thickness. This material had to be hauled distances ranging from a few hundred feet to 1½ miles on other portions, the average haul being 4,000 feet.

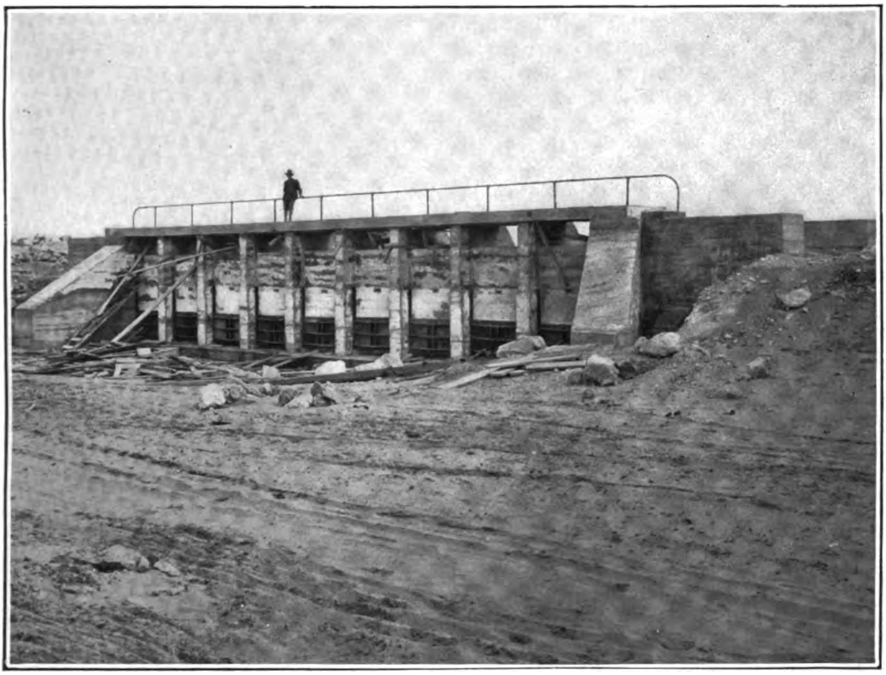
OUTLET AND DISTRIBUTING CANALS.

The outlet from the reservoir is through a canal reaching from the center of the reservoir to Hondo River, a distance of 5,300 feet. The canal has a bottom width of 10 feet and a maximum depth of 14 feet. This canal is crossed by one of the embankments, and the water is drawn through this embankment by means of two 3-foot cast-iron pipes embedded in a concrete base with concrete rings around the entire structure to intercept creeping waters. On the reservoir side the pipes enter a reenforced concrete tower (Pl. LXIII). A cast-iron gate regulates the flow into the tower and each pipe is provided with a valve, all operated with screws and ball-bearing stands from the platform on top of the tower. A steel footbridge leads from the top of the embankment to the tower platform. The discharge end of the pipes is protected by a concrete basin, and the canal is also riprapped for some distance.

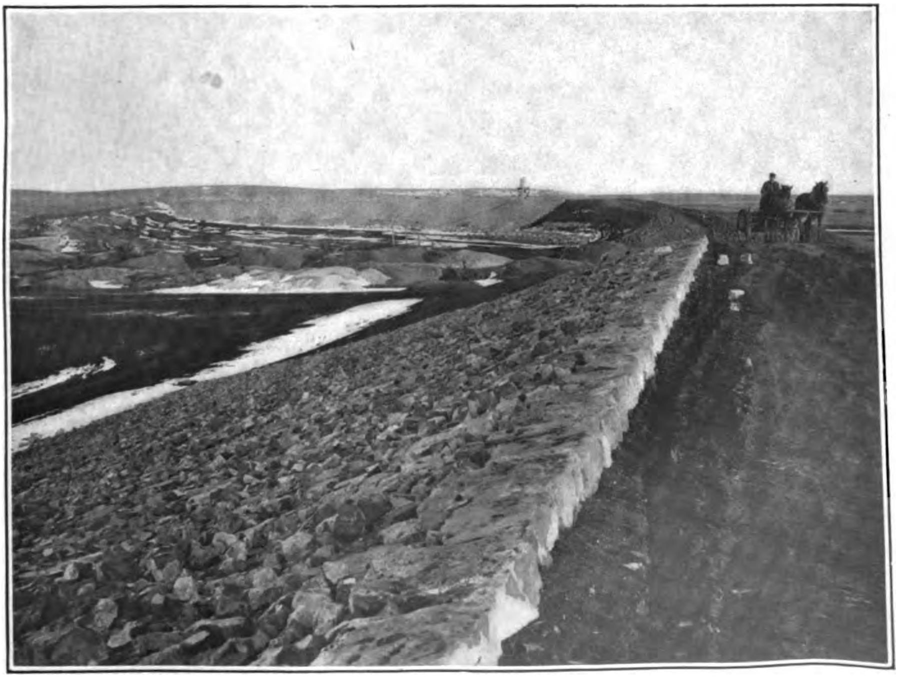
The water is discharged from the outlet canal into the channel of the Hondo, which is utilized for conveying the water to the edge of the irrigated district, a distance of about 1 mile. Three diversion dams were built at different points for distributing the water to the irrigated section.

Hondo River usually overflows its banks several times a year, and as the water carries much silt, the river banks have been built up higher than the surrounding country, and it is possible to run ditches almost at right angles to the course of the stream. The canals are taken out on a grade level with the bottom of the river and a very low dam serves to divert the water. The bottom and sides of the structure are constructed of concrete. The water is diverted by means of flashboards resting against a frame that can be dropped at will, leaving the bed of the river entirely free from any obstruction. The entrance to the distributing laterals is controlled by concrete structures with iron gates operated by screws and stands.

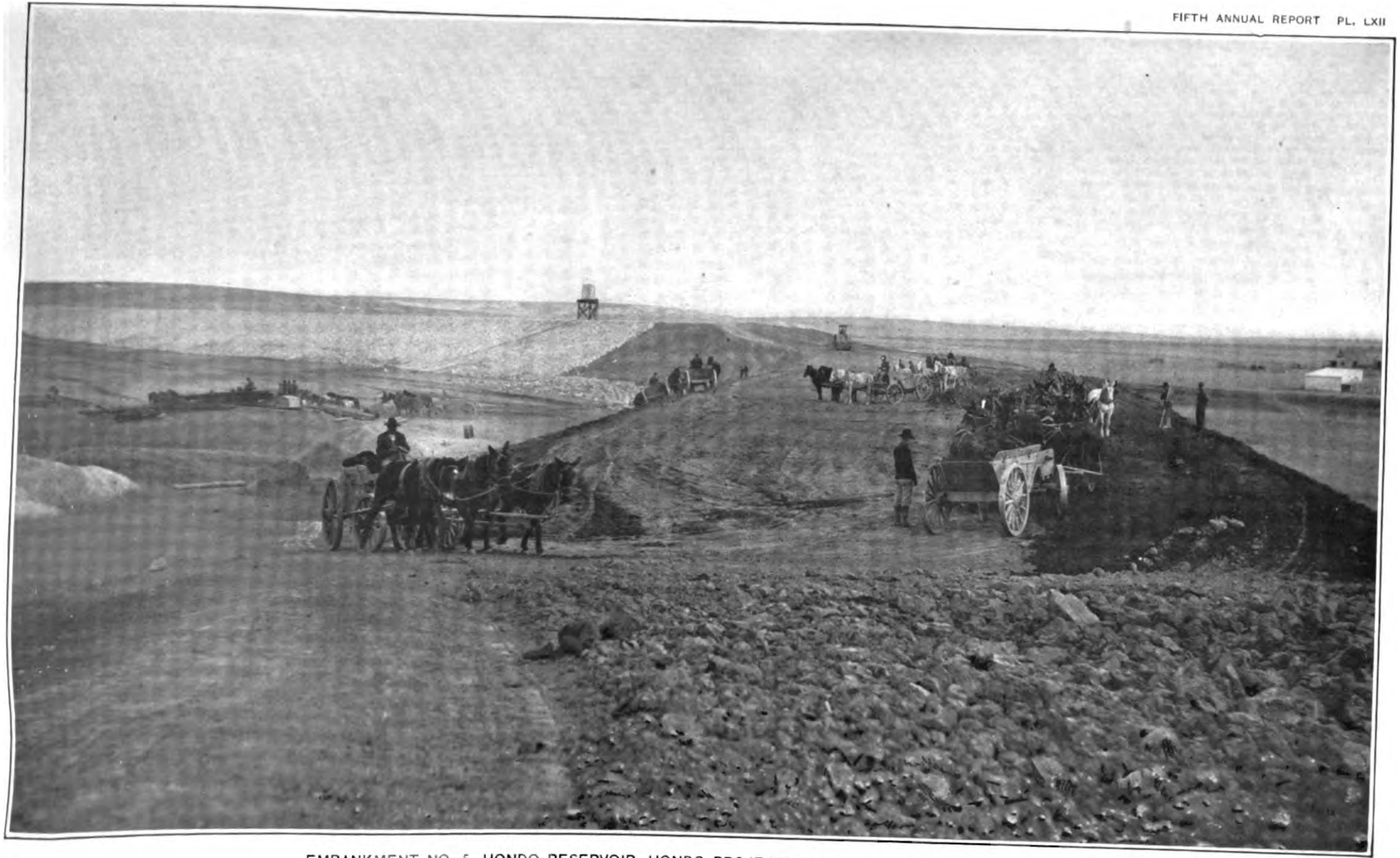
As the irrigated district has a slope about 25 feet to the mile, it was necessary to provide frequent drops in the canal in order to prevent erosion from high velocity. These drops vary from 3 to 8 feet in height and are built of concrete and grouted paving. A head wall is used at the higher elevation. From this the earth section is prepared on a grade of 16 per cent and thoroughly compacted. This earth section is covered with a rough paving and thoroughly grouted with cement mortar. At the lower end a basin is constructed of the same kind of material. At the lower end of the basin several small baffle piers are constructed to prevent the water entering the earth section at a higher velocity. The material through which the distributing system is constructed is sufficiently impervious to make lining unnecessary, but all gates, checks, weirs, and turnouts are built of concrete or reenforced concrete.



A. SPILLWAY NO. 1, ON INLET CANAL, HONDO PROJECT, NEW MEXICO, JANUARY 31, 1906.



B. SECTION OF COMPLETED EMBANKMENT, NO. 5 SHOWING CHARACTER OF PAVING, HONDO PROJECT, NEW MEXICO, DECEMBER 29, 1905.



EMBANKMENT NO. 5, HONDO RESERVOIR, HONDO PROJECT, NEW MEXICO, JANUARY 31, 1906.

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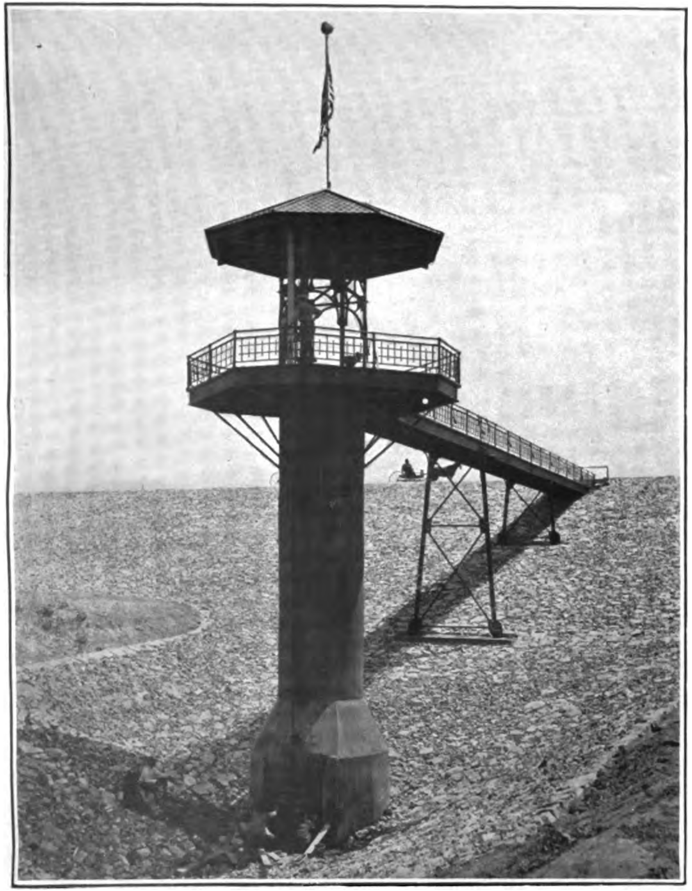
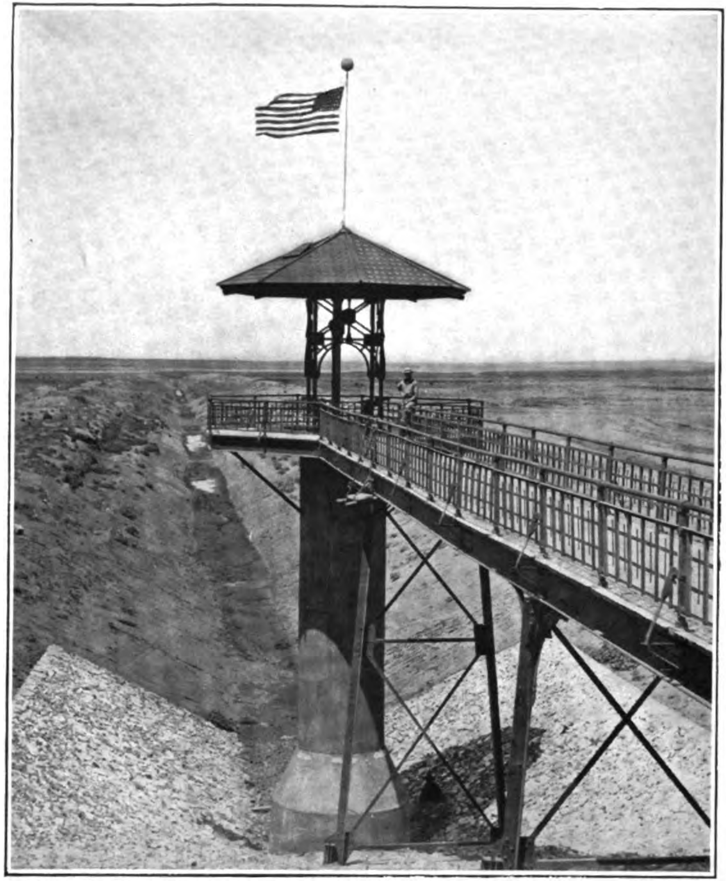


A. OUTLET TOWER OF HONDO RESERVOIR, HONDO PROJECT, NEW MEXICO, JULY 19, 1906, SHOWING PAVED EMBANKMENT.



B. OUTLET TOWER OF HONDO RESERVOIR, HONDO PROJECT, NEW MEXICO, JULY 19, 1906, SHOWING OUTLET CHANNEL FROM DEEPEST PART OF RESERVOIR.

Bids on the earthwork for the distribution system were opened February 1, 1906, and the contract was awarded to T. F. Cazier, of Roswell, N. Mex.

Bids opened February 1, 1906 for earthwork on distributing system, Hondo project.

Kind of work.	Quantity.	T. F. Cazier, Roswell, N. Mex.		Wood, Bancroft & Doty, Omaha, Nebr.	
		Unit price.	Amount.	Unit price.	Amount.
Excavation:					
Class 1 . . . . cubic yards..	32,000	$0.14	$4,480.00	$0.17	$5,440.00
Class 2 . . . . do....	200	.50	100.00	.55	110.00
Class 3 . . . . do....	200	1.00	200.00	1.00	200.00
Overhaul . . . . do....	1,000	.015	15.00	.015	15.00
Laterals, 2 feet bottom width . . . . . . miles..	38	140.00	5,320.00	225.00	8,550.00
Total	. . . .	. . . .	10,115.00	. . . .	14,315.00

TELEPHONE LINE AND OFFICE BUILDING.

A telephone line has been built from Roswell to the reservoir. This line is located through the center of the farming section, and will be available for use by the farmers as well as the Government's operating employees. The length of the line is 14.7 miles. A five-room house has also been built at the reservoir. This has been used by the engineers, and will be the residence of the watchman and gate keeper during the operation of the system.

IRRIGABLE LANDS.

The land is now mostly in the hands of people ready to begin active farming whenever water is delivered. Several places are now being improved, and some crops were planted during the past year.

EXPENDITURES.

The expenditures on the Hondo project are shown in the following tables:

Expenditures, according to physical features, on Hondo project to June 30, 1906.

Features.	Engineering and administration.	Building.
Incidental structures:		
Telephone line	$30.00	$3,156.37
House for gate keeper	20.00	1,563.06
Well, windmill, and fixtures	. . . .	1,110.39
Irrigation structures:		
Hondo reservoirs, lands submerged	. . . .	20,000.00
Embankments (including diversion dam)	6,026.35	123,313.13
Inlet canal	2,332.23	41,179.35
Outlet canal	2,884.00	28,983.19
Structures	1,401.66	38,691.05
Distributing system	1,305.00	11,397.94
Irrigable lands:		
Farm unit subdivision and soil examination	12,136.27	. . . .
Water Users' Association	10.00	. . . .
Examination of project as a whole	3,152.39	3,497.37
Administration of project as a whole	751.40	746.32
Total	30,049.30	273,638.17
Grand total	. . . .	303,687.47

Expenditures, according to purpose and nature, on Hondo project to June 30, 1906.

[Total, $303,687.47.]

	Services.	Traveling.	Subsistence.	Equipment.	Materials.	Supplies.	Rent and storage.	Forage.	Job work.
Engineering:									
Examination	$4,045.28	$1,218.22	$725.77	$351.83	....	$296.26	$12.40	....	....
Survey and inspection	7,356.95	1,173.91	1,363.62	1,051.71	....	1,007.95	53.33	$114.80	....
Design	756.01	97.95	....	62.32	....	48.72	7.42	....	....
Subdivision	296.19	25.95	....	37.08	....	92.44	7.42	....	....
Building:									
Rights and property	264.85	187.29	....	20,000.00	....	....	....	....	....
Building	123,004.93	1,324.89	2,222.64	2,582.96	$14,079.72	13,753.73	517.97	11,255.01	$84,444.18
Administration	6,372.73	625.50	439.22	988.26	....	1,197.72	131.34	90.00	....

PROPOSED LAS VEGAS PROJECT.

The Third Annual Report contains a description of this project. It is located at Las Vegas, N. Mex., and contemplates the irrigation of 10,000 acres by diverting waters of the Sapello and Gallinas rivers, Sanquijuela Creek, and Arroyo Pecos, and storing them in a reservoir in the valley of the Little Sanquijuela. The only work done during the present year has been stream measurements. The expenditures are summarized in the following table:

Expenditures, according to purpose and nature, on proposed Las Vegas project to June 30, 1906.

[Total, $4,233.30.]

	Services.	Traveling.	Subsistence.	Equipment.	Supplies.	Forage.
Engineering: Examination	$2,342.12	$504.59	$496.78	$346.57	$257.39	$94.62
Administration	109.32	19.66	26.15	18.05	13.07	4.98

PROPOSED URTON LAKE PROJECT.

This project is described in the Third Annual Report. It is located in Leonard Wood County and contemplates the irrigation of 60,000 acres by diverting water from Pecos River near old Fort Sumner, and conveying it in a canal 35 miles long to Urton Lake. This lake is a natural depression in which 190,000 acre-feet of water can be stored. Surveys and estimates have been made and the project has been reported on by a board of engineers. The only work done during the present year has been stream measurements, for the purpose of getting all the information possible concerning the water supply. The expenditures are summarized in the following table:

Expenditures, according to purpose and nature, on proposed Urton Lake project to June 30, 1906.

[Total, $17,762.24.]

	Services.	Traveling.	Subsistence.	Equipment.	Supplies.	Rent and storage.	Forage.
Engineering:							
Examination	$9,333.43	$1,705.53	$2,460.00	$1,626.89	$1,253.03	$2.00	$468.59
Survey	38.00	11.02	....	....	....	....	....
Rights and property	....	7.00	....	....	....	....	....
Administration	477.78	70.69	129.48	89.40	64.74	....	24.66

PROPOSED LA PLATA VALLEY PROJECT.

This project is located in the northwest corner of New Mexico and is described in the Fourth Annual Report. No work has been done during the present year. The expenditures are summarized in the following table:

Expenditures, according to purpose and nature, on proposed La Plata Valley project to June 30, 1906.

[Total, $27,697.03.]

	Services.	Traveling.	Subsistence.	Equipment.	Supplies.	Rent and storage.	Forage.
Engineering:							
Examination	$13,615.97	$1,379.93	$4,109.35	$14.79	$2,139.66	$70.00	$993.11
Survey	2,076.72	237.58			57.36		
Rights and property					59.50		
Administration	1,691.41	120.38	304.88	173.23	197.80	393.00	62.36

NEW MEXICO-TEXAS.

RIO GRANDE PROJECT.

LEASBURG DIVERSION.

GENERAL STATEMENT.

A summary of the principal data relating to the Leasburg diversion is given below:

Summary of principal data relating to Leasburg diversion.

County: Dona Ana.
Latitude: 32°.
Longitude: 106° 47′.
Townships: T. 22 S., R. 1 E.; T. 23 S., Rs. 1 and 2 E.; T. 24 S., R. 2 E.
Irrigable area: 15,000 acres.
Watershed area: 37,000 square miles.
Average rainfall: 9.4 inches.
Estimated run-off: 500,000 acre-feet past Lascruces; 800,000 acre-feet past Engle.
Range of temperature: Maximum, 110°; minimum, 0°.
Average elevation: 3,850 feet.
Principal products: Alfalfa, corn, fruit, vegetables, and melons.
Nearest railroad: Atchison, Topeka and Santa Fe runs through tract.
Nearest stations: Lascruces, Dona Ana, and Mesilla Park.
Principal market: El Paso, Tex.
Kind of headworks: Concrete diversion wier in river, with sluice and head gates.
Duty of water: 2½ acre-feet per acre on land.
Height of dam: 5 feet.
Length of dam: 600 feet of concrete and 1,500 feet of earth embankment.
Type of dam: Concrete weir and earth embankment.
Length of canals: 6 miles.
Ownership of lands: Private.
Character of soil: Fertile alluvium.
Value of irrigated lands: $100 to $150.
Date of completion of Leasburg diversion: March, 1907.

The Third Annual Report contains a full discussion of the interstate and international problems involved in an equitable division of the waters of the Rio Grande, and sets forth in detail the features of the Rio Grande project. It is proposed to build an immense storage dam across the Rio Grande near Engle, N. Mex., that will form a reservoir with a maximum water depth of 175 feet, a length of 40 miles, and a storage capacity of 2,000,000 acre-feet, and to build a system of diversion dams and canals along the river below in New Mexico and Texas. Water will be provided for 180,000 acres—110,000 acres in New Mexico, 45,000 acres in Texas, and about 25,000 acres in Mexico.

In order to make the project feasible, Congress has extended the provisions of the reclamation act to the State of Texas, and a treaty has been entered into with the Republic of Mexico in which the United

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[a] For general map, see Third Ann. Rept. Reclamation Service, Pl. XLVII.

States agrees to furnish in the river bed at the head of the old Mexican Canal near El Paso 60,000 acre-feet of water per annum to be used in Mexico. This is approximately the amount of water that has been used for about three hundred years in the old Mexican Canal prior to 1880, since which time irrigation by American citizens on the headwaters in Colorado has caused a deficiency in the low-water flow of the river at the head of the canal. In return, the Mexican Government has waived all other claims to water in the Rio Grande above the town of Fort Quitman, Tex., and all claims for past damages from shortage of water. Following is the text of the act extending the reclamation act to Texas:

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the provisions of the act entitled "An act appropriating the receipts from the sale and disposal of public lands in certain States and Territories to the construction of irrigation works for the reclamation of arid lands," approved June seventeenth, nineteen hundred and two, be, and the same are hereby, extended so as to include and apply to the State of Texas.

Approved June 12, 1906.

The treaty with Mexico is as follows:

The United States of America and the United States of Mexico being desirous to provide for the equitable distribution of the waters of the Rio Grande for irrigation purposes, and to remove all causes of controversy between them in respect thereto, and being moved by considerations of international comity, have resolved to conclude a Convention for these purposes and have named as their Plenipotentiaries:

The President of the United States of America, Elihu Root, Secretary of State of the United States; and

The President of the United States of Mexico, His Excellency Senor Don Joaquin D. Casasus, Ambassador Extraordinary and Plenipotentiary of the United States of Mexico at Washington;

Who, after having exhibited their respective full powers, which were found to be in good and due form, have agreed upon the following articles:

ARTICLE I.

After the completion of the proposed storage dam near Engle, New Mexico, and the distributing system auxiliary thereto, and as soon as water shall be available in said system for the purpose, the United States shall deliver to Mexico a total of 60,000 acre-feet of water annually, in the bed of the Rio Grande at the point where the head works of the Acequia Madre, known as the Old Mexican Canal, now exist above the City of Juarez, Mexico.

ARTICLE II.

The delivery of the said amount of water shall be assured by the United States and shall be distributed through the year in the same proportions as the water supply proposed to be furnished from the said irrigation system to lands in the United States in the vicinity of El Paso, Texas, according to the following schedule, as nearly as may be possible:

	Acre-feet per month.	Corresponding cubic feet of water.		Acre-feet per month.	Corresponding cubic feet of water.
January	0	0	August	4,370	190,357,200
February	1,090	47,480,400	September	3,270	142,441,200
March	5,460	237,837,600	October	1,090	47,480,400
April	12,000	522,720,000	November	540	23,522,400
May	12,000	522,720,000	December	0	0
June	12,000	522,720,000			
July	8,180	356,320,000	Total	60,000	2,613,600,000

In case, however, of extraordinary drought or serious accident to the irrigation system in the United States, the amount delivered to the Mexican Canal shall be diminished in the same proportion as the water delivered to lands under said irrigation system in the United States.

ARTICLE III.

The said delivery shall be made without cost to Mexico, and the United States agrees to pay the whole cost of storing the said quantity of water to be delivered to Mexico, of conveying the same to the international line, of measursing the said water, and of delivering it in the river bed above the head of the Mexican Canal. It is understood that the United States assumes no obligation beyond the delivering of the water in the bed of the river above the head of the Mexican Canal.

ARTICLE IV.

The delivery of water as herein provided is not to be construed as a recognition by the United States of any claim on the part of Mexico to the said waters; and it is agreed that in consideration of such delivery of water, Mexico waives any and all claims to the waters of the Rio Grande for any purpose whatever between the head of the present Mexican Canal and Fort Quitman, Texas, and also declares fully settled and disposed of, and hereby waives, all claims heretofore asserted or existing, or that may hereafter arise, or be asserted, against the United States on account of any damages alleged to have been sustained by the owners of land in Mexico, by reason of the diversion by citizens of the United States of waters of the Rio Grande.

ARTICLE V.

The United States, in entering into this treaty, does not thereby concede, expressly or by implication, any legal basis for any claims heretofore asserted or which may be hereafter asserted by reason of any losses incurred by the owners of land in Mexico due or alleged to be due to the diversion of the waters of the Rio Grande within the United States; nor does the United States in any way concede the establishment of any general principle or precedent by the concluding of this treaty. The understanding of both parties is that the arrangement contemplated by this treaty extends only to the portion of the Rio Grande which forms the international boundary, from the head of the Mexican Canal down to Fort Quitman, Texas, and in no other case.

ARTICLE VI.

The present Convention shall be ratified by both contracting parties in accordance with their constitutional procedure, and the ratifications shall be exchanged at Washington as soon as possible.

In witness whereof, the respective plenipotentiaries have signed the Convention both in English and Spanish languages, and have hereunto affixed their seals.

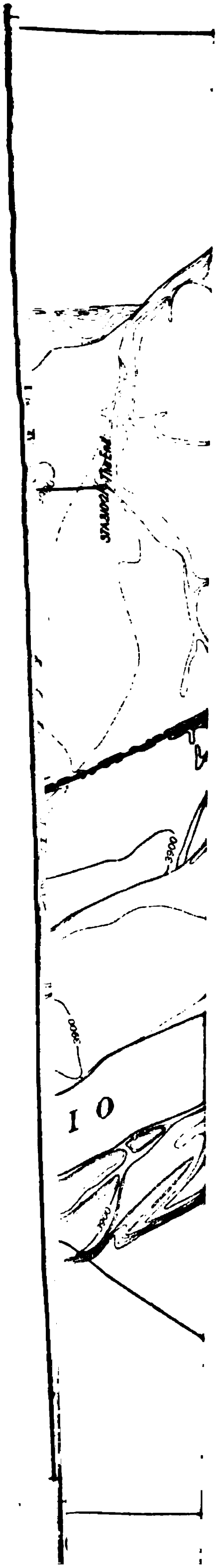
Done in duplicate at the City of Washington, this 21st day of May, one thousand nine hundred and six.

ELIHU ROOT [SEAL]
JOAQUIN D. CASASUS [SEAL]

Instead of interfering with existing diversions in Colorado, which have caused a deficiency of water for irrigation not only in Mexico, but in New Mexico and Texas as well, it is proposed to utilize, by storage, the unappropriated waters that now flow to the Gulf periodically in enormous and disastrous floods. The citizens of New Mexico and Texas will pay back to the reclamation fund their proportionate share of the cost, but it is expected that Congress will appropriate the money necessary for furnishing to Mexico the amount of water agreed upon. This sum will be about $1,000,000.

DIVERSION DAM AND CANAL.

As diversion dams for canal headings are a necessary part of this general project, and as the immediate building of one of these will be of great present benefit to the people of Mesilla Valley, near Las Cruces, N. Mex., in furnishing a permanent heading for the present canal systems, the first work that will be taken up, as part of the Rio Grande project, will be the Leasburg diversion dam and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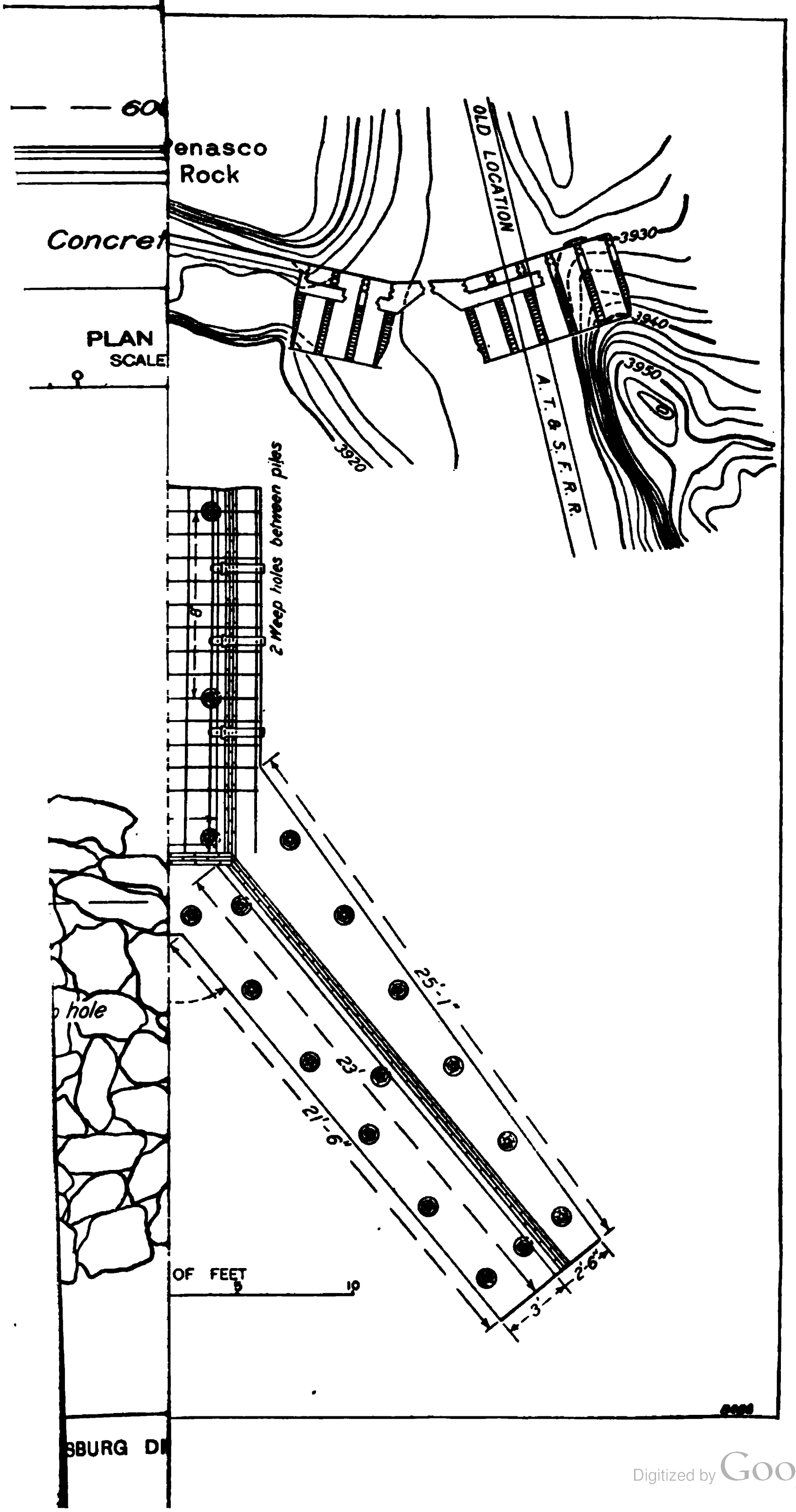
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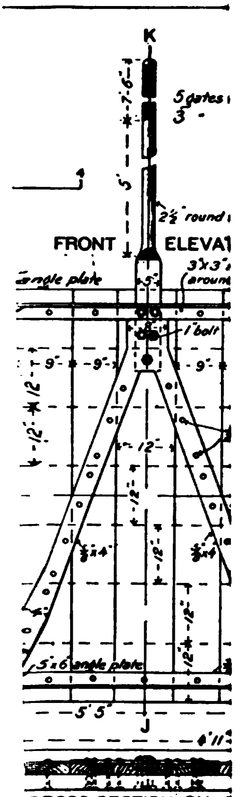

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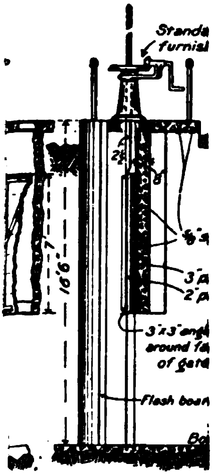


ATION SECTIONAL

CO-TEXAS.

canal. (Pls. LXIV–LXVIII.) An allotment of $200,000 was approved by the Secretary of the Interior on December 2, 1905. This diversion will ultimately form the heading of the Mesilla Valley canal, which will be the largest canal of the project.

The first site chosen for this dam was at Penasco Rock, near old Fort Selden, about 17 miles north of Las Cruces, but a full investigation showed that the Santa Fe Railroad occupied the only ground on which it would be practical to excavate a canal at a reasonable cost, and a site lower down the river was chosen on that account. Recently, however, the alignment of the railroad has been changed and the ground that it then occupied is now available for a canal. The diversion dam will therefore be built at Penasco Rock, which projects into the river from the left bank, and will form an excellent abutment for the dam and a permanent site for head gates and sluice gates. The proposed site is at the head of the Mesilla Valley, which extends from this point down the river to the upper end of "The Pass," about 6 miles above the city of El Paso.

The plans provide for a reenforced concrete diversion weir 600 feet long and 30 feet wide, resting on piles and sheet piling, with Penasco Rock as its east abutment and a concrete pier at its west end; about 1,600 feet of earth embankment at the west end; sluice ways and head-gates in Penasco Rock; 6 miles of canal for connecting head works with existing canals in the valley; sand sluices, drops, and arroyo crossing on canal; and a change of the river channel about 1½ miles below Penasco Rock in order to confine the river to the west side of the valley.

IRRIGATED LANDS.

The two water users' associations under the Rio Grande project are the Elephant Butte Water Users' Association of New Mexico and the El Paso Valley Water Users' Association of Texas. These associations have executed a joint contract with the Secretary of the Interior guaranteeing the return in ten annual installments of the $200,000 to be expended for this work. This money will be paid, however, by the landowners of 15,000 acres near Las Cruces, who will be immediately benefited by the diversion works, and the accumulated payments will be accepted as a credit on the amount that will be due for the reclamation of the said land when the entire Rio Grande project is completed.

Since the approval of this project and the execution of the treaty with Mexico there has been a very decided increase in land values in the entire area to be included.

EXPENDITURES.

The expenditures on the Leasburg diversion and on the Rio Grande project exclusive of the Leasburg diversion are summarized in the following tables:

Expenditures, according to physical features, on Leasburg diversion to June 30, 1906.

Features.	Engineering and administration.	Building.
Irrigation structures:		
Diversion dam	$216.77	....
Headworks and gates	217.36	....
Canal	4,654.99	....
Irrigable lands:		
Farm-unit subdivision and soil examination	91.90	....
Water Users' Association	92.45	....
Irrigable lands—Cont'd.		
Examination of project as a whole	$232.40	....
Administration of project as a whole	1,327.61	....
Total	6,833.48	....

Expenditures, according to purpose and nature, on Leasburg diversion to June 30, 1906.

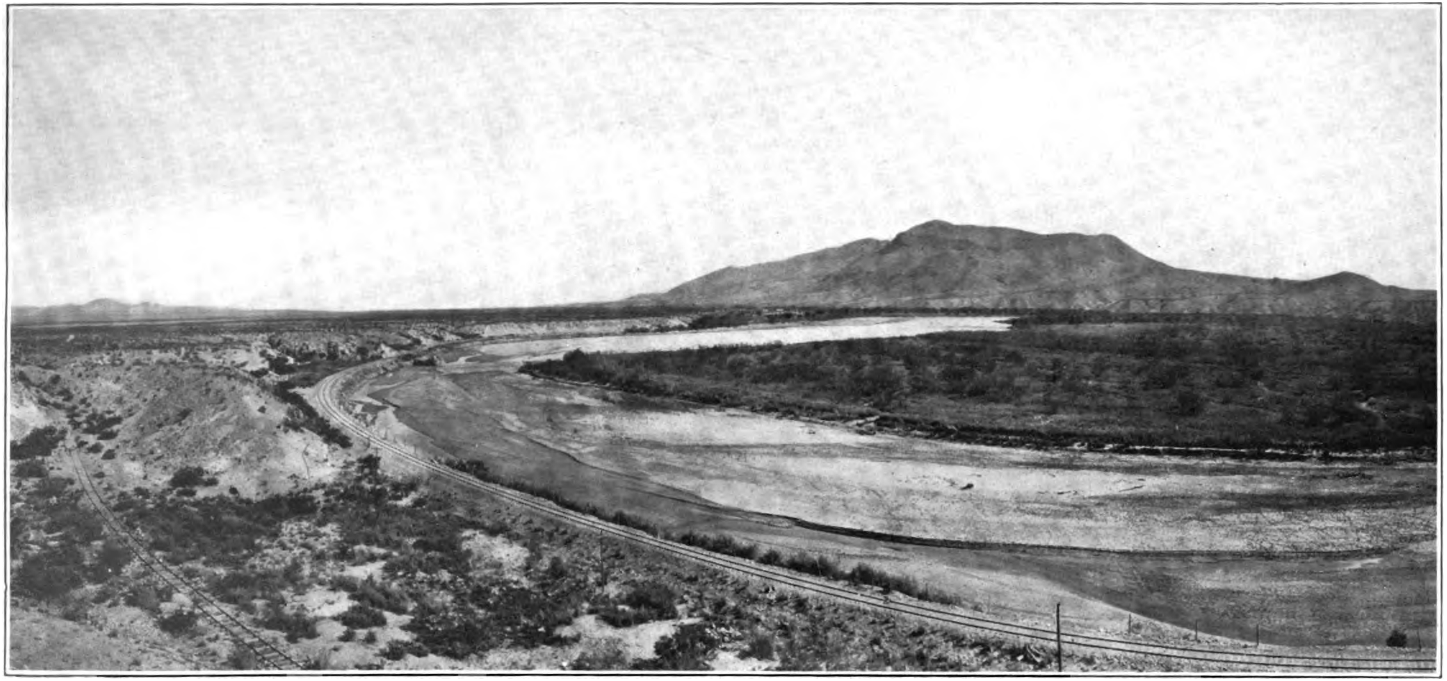
[Total, $6,833.48.]

	Services.	Traveling.	Subsistence.	Equipment.	Supplies.	Rent and storage.	Forage.
Engineering;							
Examination	$170.66	$49.60	$23.77	$13.90	$24.32	$16.14	$5.67
Survey	2,322.03	129.17	474.35	28.07	166.33	175.23	397.20
Design	656.60	6.13	....	8.76	12.40	1.75	....
Subdivision	69.94	6.13	....	8.76	110.70	1.75	....
Building:							
Rights and property	70.00	9.40	....	....	15.20	....	....
Building	5.10	....	....	....	5.97	....	....
Administration	1,398.95	152.70	....	93.26	180.39	23.15	....

Expenditures, according to purpose and nature, on Rio Grande project, exclusive of Leasburg diversion to June 30, 1906.

[Total, $48,404.15.]

	Services.	Traveling.	Subsistence.	Equipment.	Supplies.	Rent and storage.	Forage.
Engineering;							
Examination	$21,436.16	$2,712.82	$4,908.12	$3,407.47	$2,388.39	$464.51	$1,035.65
Survey	5,788.99	585.64	1,362.87	867.68	599.36	117.83	318.46
Administration	1,481.65	159.20	306.19	228.44	163.96	20.06	50.70



THE LEASBURG DIVERSION DAM SITE, RIO GRANDE PROJECT, NEW MEXICO-TEXAS, FROM A POINT ON THE EAST BANK OF THE RIO GRANDE ABOUT HALF A MILE UPSTREAM FROM PENASCO ROCK.

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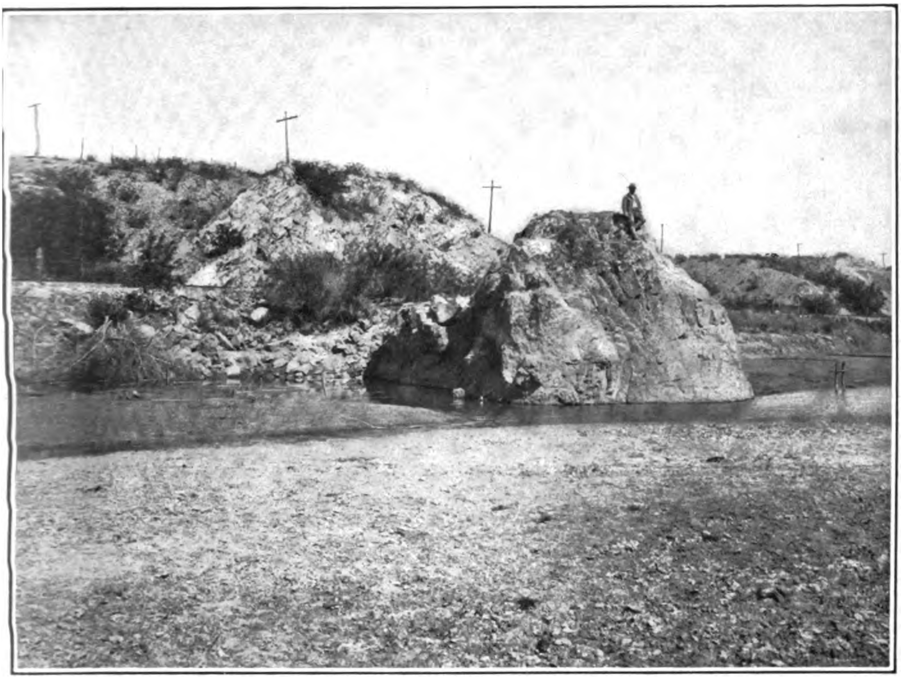
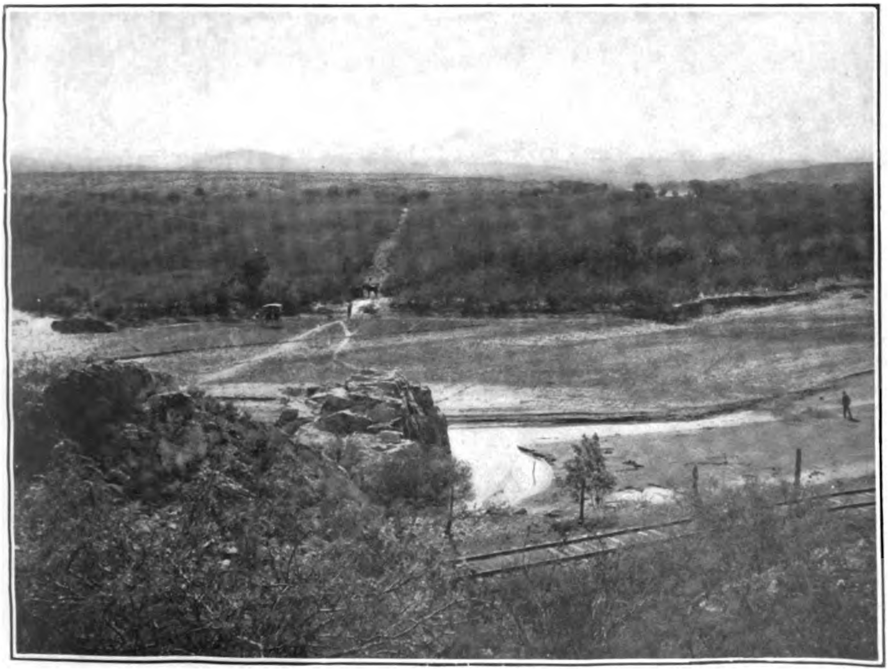


A. PENASCO ROCK, THE EAST ABUTMENT OF THE LEASBURG DIVERSION DAM, RIO GRANDE PROJECT, NEW MEXICO-TEXAS.



B. THE LEASBURG DIVERSION DAM SITE, RIO GRANDE PROJECT, NEW MEXICO-TEXAS, FROM THE EAST ABUTMENT, PENASCO ROCK IN FOREGROUND.

NORTH DAKOTA.

WILLISTON DISTRICT PROJECTS.

GENERAL FEATURES.

The Buford-Trenton, Williston, and Nesson projects, comprising the Williston district, are located in Williams County, on the left bank of Missouri River. It is proposed to pump water from Missouri River into canals crossing the valley and bench lands. Lignite coal mined on Government lands adjacent to the pumping plants will be used as fuel.

General discriptions of these projects are given in the Third Annual Report, pages 439 to 442, and in the Fourth Annual Report, pages 283 to 287. In the latter report are described the operations carried on during the season of 1905, practically to the close of the year. Several features of the pumping projects are common to them all, and these will be briefly discussed before describing the projects in detail.

FUEL VALUE OF LIGNITE.

The actual fuel value of Williston lignite coal, which is to be used in the proposed power and pumping plants, was determined by a series of tests in Denver in steam-boiler furnaces that had been designed for burning low grades of Colorado lignites. The results are shown in the following table:

Results of tests of Williston lignite.

[North Dakota lignite from Miller mine at Williston.]

	I.[a]	II.[a]	III.[a]	IV.[a]	V.[b]
Method of starting and stopping the test	....	Alternate.	Alternate.	Alternate.	Alternate.
Grate surface......square feet..	16.875	16.875	14.125	14.125	52.2
Water heating surface....do....	826	826	826	826	3,467
Superheating surface.....do....	0	0	0	0	0
Date of trial	Oct. 11, 1905	Oct. 14, 1905	Oct. 16, 1905	Oct. 19, 1905	Oct. 26, 1905.
Duration of trial........hours..	6	5½	5½	6	7
Weight of fuel as fired.pounds..	4,400	3,440	2,640	3,600	10,407
Percentage of moisture in fuel...	39.33	40.62	39.62	36.56	36.63
Total weight of dry fuel consumed..............pounds..	2,689.5	2,086	1,594	2,284	6,367
Total weight of water fed to boiler................pounds..	17,039	14,715	10,836	13,799	45,990.06
Water actually evaporated, corrected for moisture of superheat in steam......pounds..	16,869	14,568	10,727.6	13,661	45,990.06
Factor of evaporation..........	1.19	1.198	1.197	1.199	1.21
Equivalent water evaporated into dry steam from and at 212°..................pounds..	20,073.6	17,434	12,845	16,393	55,647.97
Dry fuel consumed per hour pounds..	444.7	371.4	303.7	380.7	909.8

[a] Test made at Johnson Furnace Company's experimental plant, Denver, Colo. Boiler, old style tubular 60 inches by 16 feet, 36 4.5 inches tube, furnace, Johnson.

[b] Test made at plant of Great Western Sugar Company, Fort Collins, Colo. Boiler, B and W water tube, 18 feet long, 168 4-inch tubes, 2 42-inch drums, furnace, Johnson.

Results of tests of Williston lignite—Continued.

	I.	II.	III.	IV.	V.
Dry fuel per square foot of grate surface per hour.....pounds..	26.35	21.98	21.50	26.94	129.9
Water evaporated per hour corrected for quality of steam, pounds..	2,811.5	2,650	2,047	2,277	6.5[illegible]
Water evaporated per hour from and at 212°.....pounds..	3,345.6	3,172	2,450.	2 732	7.9[illegible]
Equivalent evaporation per hour from and at 212° per square foot of heating surface pounds..	4.051	3.840	2.967	3.309	2.5[illegible]
Steam pressure by gage, pounds..........	70.0	74.2	74.3	68.4	[illegible]
Temperature of feed water entering boiler.............° F..	66.525	55.8	55.5	51.76	47.6[illegible]
Temperature of escaping gases from boiler..............° F..	533.5	517.5	448.0	422	450[illegible]
Percentages of moisture in steam, or number of degrees superheat......................	1	1	[a] 1	[a] 1	[b]
Horse power developed..........	97	92.1	71.0	79.3	[illegible]
Builders' rated horsepower......	75	75	75	75	[illegible]
Percentage of builders' rated horsepower developed.........	129.4	122.9	94.7	105.8	[illegible]
Water apparently evaporated under actual conditions, per pound of fuel as fired.pounds..	3.87	4.28	4.27	3.83	4.4[illegible]
Equivalent evaporation from and at 212° per pound of fuel as fired..............pounds..	4.55	5.07	4.86	4.56	[illegible]
Equivalent evaporation from and at 212° per pound of dry fuel.................pounds..	7.52	8.36	8.06	7.174	8.74
Calorific value of the dry fuel per pound...........B. T. U..	10,500	11,280	11,630	10,880	11,3[illegible]
Efficiency of boiler, including grate (based on dry fuel)......	69.14	71.55	66.88	63.66	74.9[illegible]
Moisture..............per cent..	39.33	40.62	39.62	36.56	[illegible]
Volatile.....................do....	27.20	29.64	27.87	27.85	27.5[illegible]
Ash.........................do....	4.22	4.10	3.88	6.26	[illegible]
Fixed carbon...............do....	29.25	25.64	28.63	29.33	[illegible]
Sulphur....................do....	.44	.30	.30	1.44	.64

[a] Assumed. [b] Assumed dry.

COST OF LIGNITE.

Since the lignite fuel for these pumping projects will be mined on Government lands, adjacent to the power and pumping plants, the only expense for fuel will be the actual cost of mining and transporting it to the plants. The usual cost of mining in this State is 75 to 85 cents per ton. The veins are nearly level and are usually mined through entries made in an outcrop along a steep hillside. The cost of transportation varies with the distance hauled, and for the usual downhill haul of about one-half mile will be 15 to 25 cents per ton. The total cost per ton delivered at the plant will be about $1.25, allowing for maintenance of mining plant and tramway.

CONDITIONS CONTROLLING LOCATION OF STATIONS.

The power stations must be located close to the coal mines. They must also be close to an adequate water supply for the boilers. Some of the pumping stations must be located at the bank of the Missouri River; others where water must be pumped from a low line to a high line canal. These conditions can be satisfactorily met only by using electric power transmission.

ADVANTAGES OF USING ELECTRIC POWER.

The main generating station will be placed close to the mine, and long hauls will be avoided. The pumping stations will contain only centrifugal pumps, operated by electric motors, and their operation will be so automatic and reliable that the miminum attendance will be required. Practically all the labor for operating the systems can thus be concentrated at the main generating station. Without electric power it would be hardly feasible to install the entire intake pumping machinery on scows, as now proposed.

FLOATING PUMPING STATIONS.

By mounting centrifugal pumps driven by induction motors on large scows, compact and reliable pumping stations can be provided wherever water is to be taken from the river and delivered into canals. These floating pumping stations must be hauled out of the water each fall and launched each spring. The ice jams that occur frequently when the ice is being swept out by the first high water in the spring are likely to destroy any boat or structures encountered.

The instability of the river banks and the frequent shifting of the river channel afford ample reasons for resorting to floating pumping stations. If pumping stations of permanent construction were built close to the bank, they would probably either be cut out by the river in the course of a few years, or be separated from the river by a bar of constantly increasing width. To indicate how rapidly the river bank might recede it may be stated that at the Mondak landing, near Buford, the bank was cut back by high water about 150 feet during a few days of the June rise of 1906, and that opposite Williston the bank has been cut back over 500 feet in sixteen years. On the other hand, a bar now forming opposite Williston is already an island of several acres extent at low water, and in a few years the channel nearest the Williston bank may have silted up, thus forcing all the water into the other channel and bringing about a change of half a mile in the location of the left bank of the river at the present site of the Williston intake pumping plant.

The water will be conveyed from the pumps on the scow to the canal on shore in a large delivery pipe, which will be provided with flexible joints and be supported on pontoons. This will afford the necessary flexibility to allow the scow to be moored in deep water and to rise and fall with the change of water level in the river. Any radical changes in the bank or channel at the intake location will necessitate moving the scow up or down stream and extending the canal to correspond.

MISSOURI RIVER FLUCTUATIONS.

The rise at the opening of the river in the early spring when the ice breaks up is usually about equal to the June rise, except in the years when ice jams occur. On such occasions a rise of 25 feet above low water is not uncommon. The regularity with which this June rise occurs each year is noticeable. (Pl. LXIX.) It is not affected much by rains occurring at this time, but is due almost wholly to the melting of the winter snows in the distant mountains. That this high stage of the river occurs at about the time of greatest demand for irrigating water is fortunate, since the pumping lift of the intake pumps is least at the time when the maximum amount of water will be required of them.

SILT MEASUREMENTS.

The amounts of silt carried by Missouri River at various stages were determined during the high-water period in May and June, 1906. The silt is composed chiefly of clay and exceedingly fine sand, with a considerable portion of vegetable matter, and is valuable as a fertilizer if distributed over the land by the irrigating water, but it would cause trouble if allowed to deposit in canals. The percentages were determined by measuring the depth of sediment in glass tubes 5 to 6 feet in length. When first read the percentages by volume were as high as 40. After standing several hours the sediment becomes more compact, and at the end of two or three days becomes fairly constant in volume. The percentages mentioned below are those determined at the end of about forty-eight hours' settling. This length of time is thought to be sufficient for the deposit to acquire a density which would be sufficient to enable it to withstand the usual velocities that will occur in the canals, namely, 1½ to 2 feet per second. This determination by volume was chosen as a means of calculating the probable extent to which ditches would fill with silt during the period of high water in the river. The specific gravity of the silt was found to be about 1.12, when saturated, and 1.49 when dried to the consistency of putty. The following measurements were made to determine the rate of deposit in silt-laden water moving at a slow velocity. In a channel 750 feet long of uniform cross section and having an average velocity of 0.3 foot per second the samples of water were taken, one at the bar where the river discharged into the channel, midway the length of the channel, and at the lower end of the channel. The percentages by volume of silt deposited in forty-eight hours by the three samples were, respectively, about 6, 3, and 1.

In order to determine the amount of deposit at somewhat higher velocities, a flume having a bottom width of 12 inches was moored in the river at a point where the velocity was about 2 feet per second. This resulted in a velocity through the flume of about 1 foot per second with a depth of 8 inches. At the end of four and one-third hours the depth of sediment in the bottom of the flume, averaging 0.017 of a foot, varied from zero to 0.06 foot. The water as it entered the flume contained about 7 per cent of silt, as determined by the forty-hour settling test described above. This sediment was a fine hard sand deposited in riffles.

SETTLING BASINS.

At each intake pumping station a settling basin will be provided in order to reduce the percentage of silt carried by the water to so small an amount that further deposition will not be likely to occur when the water reaches the canals. From the experiments it seems probable that the water passing through the settling basins will deposit 5 or more per cent of its volume as saturated silt during the three or four weeks of high water. This sediment will have a density but little greater than clear water, and can be disposed of by an electrically operated suction dredge discharging into a sluiceway leading to the river.

U. S. RECLAMATION SERVICE

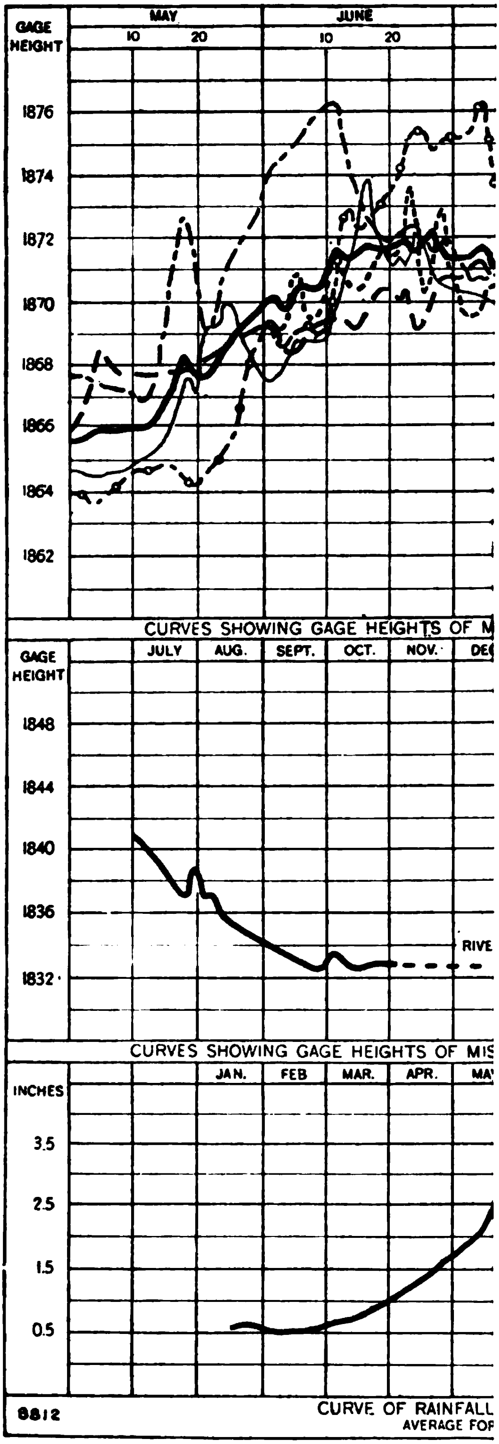


DIAGRAM SHOWING GAGE HEIGHTS OF MISSOURI
WILLIST

DUTY OF WATER.

The duty of water is assumed at 2 acre-feet per year. The actual use of water will probably be somewhat less than this except in very dry years, due to the following causes:

(1) The incentive to use water economically which results from requiring the user to pay at unit price only for the amount of water actually delivered to him.

(2) The abundant rains that frequently occur during the growing season. The pumping installations and canals are designed on the basis of delivering irrigating water constantly when necessary at the rate of 1 cubic foot per acre for each 80 acres, which would provide each acre of irrigated land in the project with the required 2 acre-feet of water in eighty days' steady operation. The irrigation season is expected to extend from about May 15 to September 15.

BUFORD-TRENTON PROJECT.

The main intake pumping station (Pls. LXX and LXXI) for the Buford-Trenton project is located on the left bank of Missouri River about 2 miles below the mouth of Yellowstone River and 1 mile from Buford station, on the Great Northern Railway. This station consists of electrically operated centrifugal pumps installed on a scow that discharges the water into a settling basin on the adjacent low bench. The pumps will have a combined capacity of 150 cubic feet per second, with an average lift of about 28 feet.

A second set of similar pumping units will be installed in a concrete building about 600 feet from the river (Pl. LXXII). They will take water from the settling basin and force it through about one-half mile of steel concrete pipe to the head of canal A, which will carry water to about 6,000 acres of cleared bench land. The total pumping lift from lowest river level is about 85 feet. The capacity of the pumps is 75 cubic feet per second.

Canal B will carry water to about 5,000 acres of bench and bottom lands, and will take water directly from the settling basin. The total length of each main canal is about 8 miles. The motors in the two stations will be supplied with 3-phase current at 2,200 volts through three 300 kilowatt transformers installed in the permanent station.

All the electric power for the Buford-Trenton project will be generated in the main power station of the Williston project. The transmission line will be about 25 miles in length, and electric power will be taken off the main line by branches extending to the intermediate stations described later. The transmission line voltage will be 22,000 volts.

An additional floating pumping station will be located in the near future on the river side of the bottom lands of the Trenton flat. It will pump water for about 2,500 acres. The average pumping lift will be about 27 feet.

On March 24, 1906, the Buford-Trenton Water Users' Association voted to enter into a contract with the Secretary of the Interior to return to the reclamation fund the cost of the completed works. The contract was executed on May 23, 1906.

The expenditures on the Buford-Trenton project are summarized in the following tables:

Expenditures, according to physical features, on Buford-Trenton project to June 30, 1906.

Features.	Engineering and administration.	Building.
Irrigation structures:		
Central power station, $3,672.63 (Buford-Trenton proportion)	$926.25	$175.5
Transmission line	50.00	
Pumping station No. 1, intake	500.00	
Pumping station No. 2	300.00	
Main canal A	1,700.00	
Main canal B	1,675.00	
Distributing system	1,125.00	
Examination of project as a whole	7,515.24	
Administration of project as a whole	3,831.05	
Total	17,622.54	175.5

Expenditures, according to purpose and nature, on Buford-Trenton project to Ju 30, 1906.

[Total, $17,798.08.]

	Services.	Traveling.	Subsistence	Equipment.	Materials.	Supplies.	Rent and storage.	Forag
Engineering:								
Examination	$3,381.18	$379.85	$415.94	$1,421.71		$227.84	$81.00	$171.4
Survey	3,177.03	402.14	1,039.25	686.33	$2.25	313.60	92.98	462.7
Design	1,338.11	131.70	12.46	17.79	.88	25.11	10.15	
Building:								
Rights and property	93.75	13.25						
Building				47.69		20.85		
Administration	2,765.16	354.29	13.68	142.23		377.49	176.51	1.

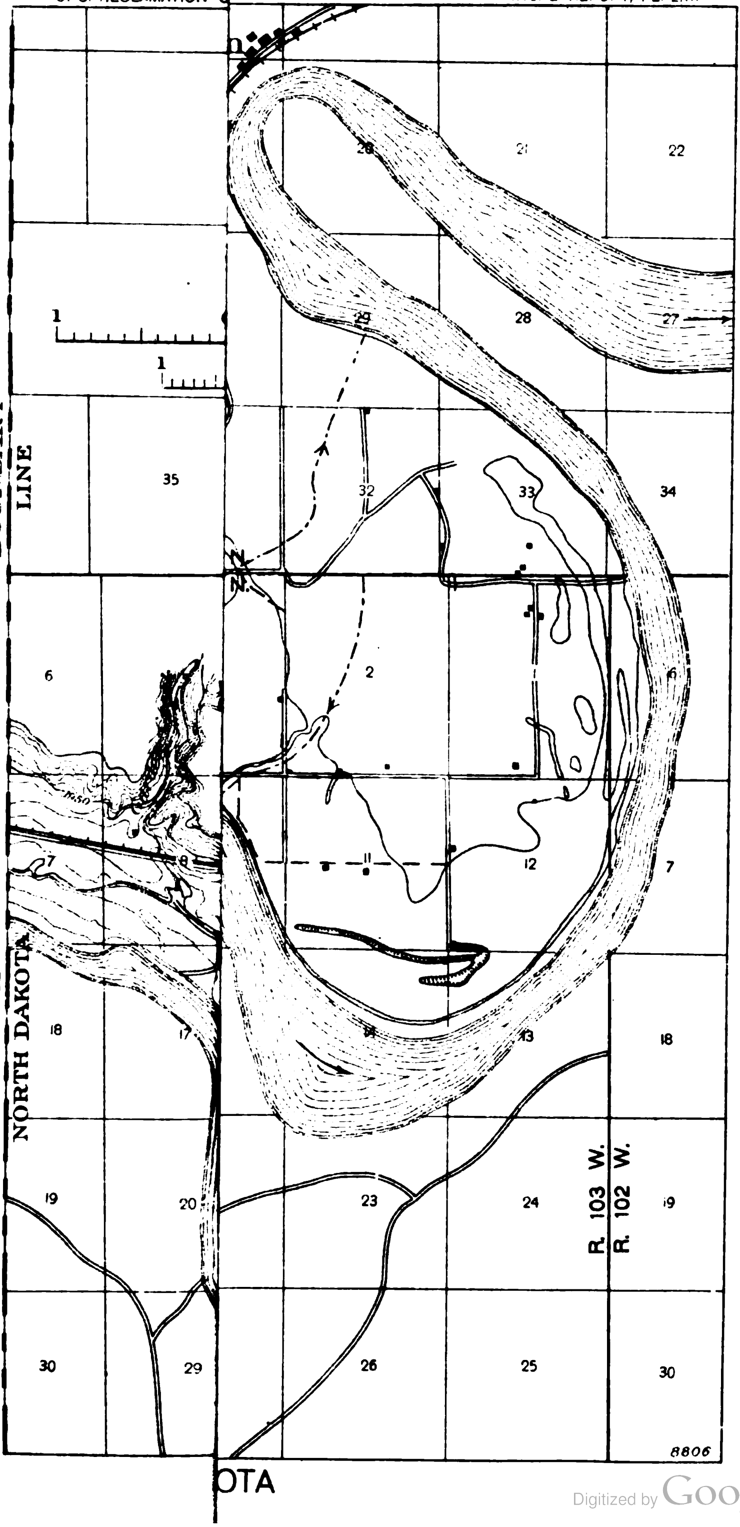
WILLISTON PROJECT.

The main intake pumping station of the Williston project (Pl. LXXIII) will be located on the left bank of Missouri River about 1,000 feet from Williston station on the Great Northern Railway. It will be a plant similar in size and design to the Buford intake station.

The settling basin is located adjacent to the above pumping plant and a main canal extends thence northward about 3 miles up the valley of Little Muddy River. Beside supplying water directly to about 500 acres of cleared land, this canal will supply three additional pumping stations with the water which they will pump through pressure pipes to higher canal lines covering about 6,500 acres of cleared bench lands.

One of these stations is at the end of the main canal and combined with it is the main power plant. About 1,500 feet east of it is the entry in the lignite vein from which the fuel will be mined. In this station will be the boiler plant and electric generating apparatus from which electric power will be transmitted to all the pumping stations of the Williston and Buford-Trenton projects. The initial installation of the steam generating plant will have about one-third the capacity of the completed plant.

The 8 electrically operated pumping stations of the Buford-Trenton and Williston projects will require a capacity of about 1,500 kilowatts in the main power station at Williston. Two pump-


BOUNDARY LINE
MONTANA
NORTH DAKOTA
1
1
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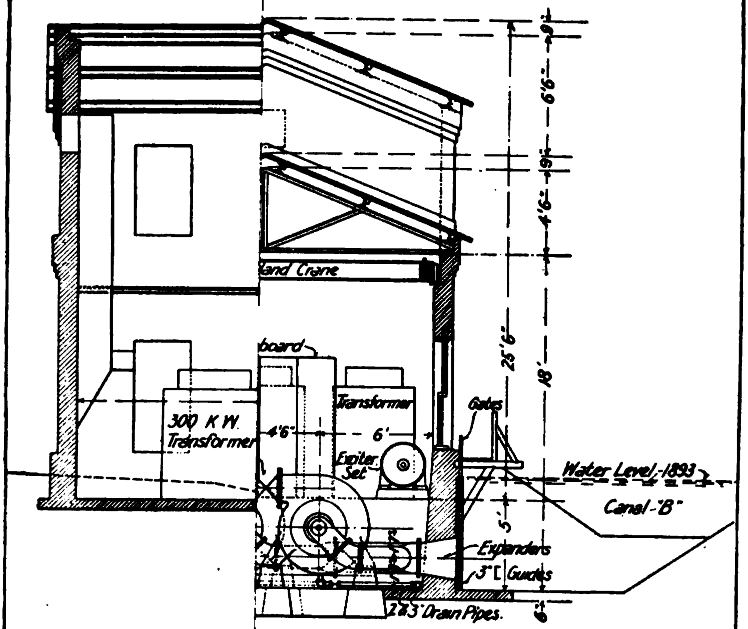
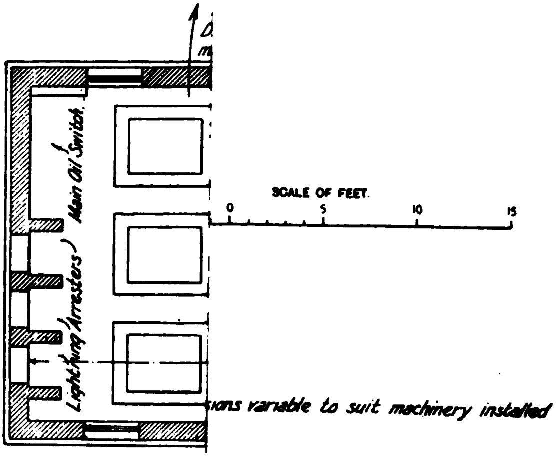


SS SECTION



ions variable to suit machinery installed

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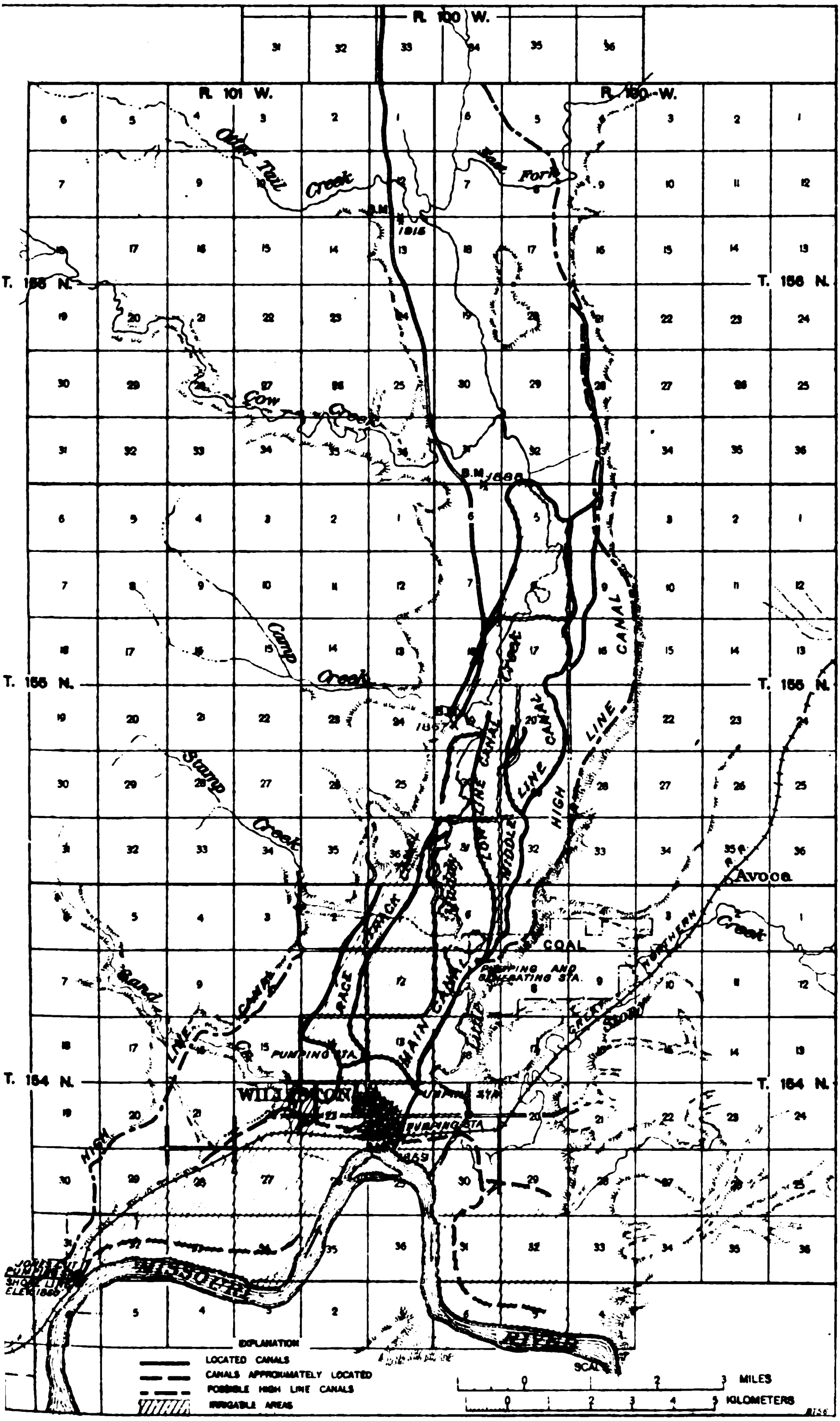

GENERAL MAP OF WILLISTON PROJECT NORTH DAKOTA

ing plants besides those mentioned above will be required for the Williston project, each to supply water to about 2,000 acres of bottom lands. The average pumping lift at the river intake pumping station is 28 feet. The high-line canals on the east and west sides of the Little Muddy Valley are about 85 feet above low water in the Missouri River.

On May 5, 1906, the Williston Water Users' Association voted to enter into a contract with the Secretary of the Interior to return to the reclamation fund the cost of the completed works. This contract was executed May 23, 1906, and construction was authorized.

The expenditures on the Williston project are summarized in the following tables:

Expenditures, according to physical features, on Williston project to June 30, 1906.

Feature.	Engineering and administration.	Building.
Irrigation structures:		
Central power station, $3,672.63, Williston proportion	$1,235.00	$234.05
Transmission line	50.00	....
Pumping station No. 1, at power plant	620.00	....
Pumping station No. 2, at power plant	410.00	....
Pumping station No. 3, at intake	205.00	....
Main supply canal	4,500.00	....
Distributing system	1,500.00	....
Examination of project as a whole	19,263.31	....
Administration of project as a whole	2,646.00	....
Total	30,429.31	234.05
Grand total	....	30,663.36

Expenditures, according to purpose and nature, on Williston project to June 30, 1906.

[Total, $30,663.36.]

	Services.	Traveling.	Subsistence.	Equipment.	Materials.	Supplies.	Rent and storage.	Forage.
Engineering:								
Examination	$6,887.87	$764.38	$837.00	$2,860.91	....	$458.45	$162.99	$345.04
Survey	6,474.69	809.21	2,091.27	1,260.36	$4.53	631.06	187.10	921.14
Design	2,692.68	265.03	25.08	35.79	1.77	50.54	16.43	....
Building:								
Rights and property	125.00	17.65	....	....	....	....	....	....
Building	....	....	....	63.59	....	27.80	....	....
Administration	1,906.89	246.66	9.48	98.52	....	261.02	122.26	1.17

NESSON PROJECT.

The principal pumping plant of the Nesson project will be located on the left bank of Missouri River near Nesson post-office, about 25 miles by wagon road from Williston and 14 from Wheelock, on the Great Northern Railway. As first planned one steam pumping plant, located near the west end of the project, about 500 feet from the river, was to take water from an open intake canal excavated 6 feet below low water and discharge directly into a low-line canal and through steel concrete pipes into two higher canals. The pumping lifts were 30, 60, and 100 feet, and the area served 2,500, 5,000, and 5,000 acres, respectively. Fuel was to be hauled about two and one-half miles from a 9-foot vein of lignite outcropping in the hills north of the plant.

Owing to the difficulty of securing the stock subscriptions of the landowners along Beaver Creek, who have acquired rights in the waters of that stream, it became desirable to cut down the area of the project by leaving out most of the lands east of Beaver Creek, about one-third of the areas given above. This reason, as well as the need of providing a settling basin to prevent an excess of silt from being pumped into the canals, led to new designs of the entire pumping machinery and canal system. These contemplate a floating intake pumping station and a second station for raising water through pipes from the settling basin to the higher canals; also the inclusion at once of about 5,000 acres of low bench land and cleared bottom lands lying on the right bank, which had been contemplated as a possible future extension of the original Nesson project.

A petition to the Secretary of the Interior for the construction of irrigation works under the provisions of the reclamation act having been signed by about 75 per cent of the owners of private lands contained in the proposed Nesson project, the Nesson Valley Water Users' Association was incorporated November 17, 1905. For the reason previously stated many of the landowners who signed the original petition have declined to subscribe for stock. Of the 19,000 acres included within the limits of the project first proposed for construction, stock subscriptions have been received for about 45 per cent of the private lands. The Government lands included amount to 10 per cent of the area.

By reducing the project to about 12,000 acres, leaving out the eastern end, the amount of private lands signed up is about 60 per cent; about 11 per cent of the land is in Government ownership. To this may be added about 5,000 acres of irrigable land on the right side of the river, 60 per cent of which is Government land. The private landowners have expressed their desire to be included in the project, but have not yet been given an opportunity to subscribe for stock.

The expenditures on the Nesson project are summarized in the following tables:

Expenditures, according to physical features, on Nesson project to June 30, 1906.

Features.	Engineering and administration.	Building.
Irrigation structures:		
Central power station ($3,672.63), Nesson proportion	$926.25	$175.54
Examination of project as a whole	14,107.85	....
Administration of project as a whole	2,572.13	....
Total	17,606.23	175.54
Grand total	....	17,781.77

Expenditures, according to purpose and nature, on Nesson project to June 30, 1906.

[Total, 17,781.77.]

	Services.	Traveling.	Subsistence.	Equipment.	Materials.	Supplies.	Rent and storage.	Forage.
Engineering:								
Examination	$3,732.52	$412.55	$451.74	$1,544.08	....	$247.45	$87.97	$186.22
Survey	3,510.90	436.75	1,128.69	680.24	$2.45	340.59	100.98	502.53
Design	1,453.28	143.03	13.53	19.32	.95	27.28	11.02	....
Building:								
Rights and property	93.75	13.25	....	....	....	....	....	....
Building	....	....	....	47.70	....	20.85	....	....
Administration	1,855.16	239.08	9.18	95.49	....	253.57	118.51	1.14

FUTURE EXTENSIONS OF PUMPING PROJECTS.

The areas which it is proposed to irrigate by means of the initial installations outlined above may be increased by the addition of higher bench lands whenever it is demonstrated that the lands to be benefited are able to stand the higher costs involved. The farmers of this section have had so little experience on irrigated lands that it has seemed wise to limit the scope of the earlier projects to lands involving only moderate pumping lifts, thus avoiding operating charges which might prove burdensome.

PROPOSED BISMARCK PROJECT.

The preliminary survey of the proposed Bismarck project was completed in the field season of 1905. The general results of this work are described in the Fourth Annual Report of the Reclamation Service, pages 287 to 289. Since the completion of the preliminary survey, the only work done on this project has been thepreparation of estimates and the continuance of the measurements of stream flow. The expenditures on this work are summarized in the following table:

Expenditures, according to purpose and nature, on proposed Bismarck project to June 30, 1906.

[Total, $14,208.67.]

	Services.	Traveling.	Subsistence.	Equipment.	Supplies.	Rent and storage.	Forage.
Engineering:							
Examination	$5,406.95	$1,324.26	$765.82	$1,751.82	$259.98	$118.76	$207.08
Survey	1,764.11	391.13	299.46	66.96	94.37		47.94
Design	352.77	27.70		3.45	7.45		
Rights and property	1.00						
Administration	1,053.81	194.91		16.61	52.33		

PROPOSED LITTLE MISSOURI PROJECT.

The work on the proposed Little Missouri project has included general reconnaissance to determine the character of the land and the investigation of the water supply. The reconnaissance work has been brought to a close, but some additional stream measurements are still being made.

A summary of the expenditures is given in the following table:

Expenditures, according to purpose and nature, on proposed Little Missouri project to June 30, 1906.

[Total, $5,889.65.]

	Services.	Traveling.	Subsistence.	Equipment.	Materials.	Supplies.	Rent and storage.	Forage.
Engineering: Examination	$3,070.73	$1,265.76	$868.84	$341.46	$11.53	$137.10	$18.00	$142.18
Rights and property						34.05		

NORTH DAKOTA-MONTANA.

LOWER YELLOWSTONE PROJECT.

GENERAL STATEMENT.

The principal data relating to the Lower Yellowstone project are summarized below:

Summary of principal data relating to Lower Yellowstone project.

Counties: Dawson, Mont.; Allred, N. Dak.
Latitude: 47°.
Longitude: 104°.
Townships: 18–26 north, Montana; 150–152 north, North Dakota.
Range: 56–60 east, Montana; 104 west, North Dakota.
Irrigable area: 66,000 acres.
Watershed area: 66,600 square miles.
Average rainfall: 16 to 20 inches.
Range of temperature: Maximum, 100°; minimum, 38°.
Average elevation: 2,000 feet.
Principal products: Forage crops.
Nearest railroad: Northern Pacific Railroad; Great Northern.
Nearest station: Glendive, Mondak.
Principal markets: Minneapolis, St. Paul, and local.
Kind of head works: Reinforced concrete.
Duty of water: 1 second-foot per 100 acres.
Length of dam: 700 feet.
Type of dam: Timber-covered rock-filled weir, pile foundation.
Length of canals: 67 miles.
Length of laterals: 205 miles.
Per cent public land: 35 per cent.
Character of soil: Deep sandy loam.
Value of irrigated land: $60 to $80 per acre.
Date of completion: 1908.

This project will provide water for the irrigation of 66,000 acres on the west side of Yellowstone River, beginning at a point about 18 miles north of Glendive and extending northward to the confluence of Yellowstone and Missouri rivers. About 20,000 acres at the northern end of the project are in North Dakota, the remainder being in Montana. At the headworks a diversion dam is contemplated, to raise the water level in the river about 6 feet. This structure will be a rock-filled timber weir on a pile foundation. In addition to the dam a reenforced concrete head-gate structure is necessary, which is now completed. It contains 11 gates, each 5 feet in diameter, for controlling water admitted to the main canal, which parallels the river for about 67 miles.

For the first 26 miles of the main canal the earthwork is heavy, 4½ miles being in thorough cut and about 13 miles in steep sidehill. Creek crossings are all on grade by means of culverts under the canal for small streams and by passing the canal in a conduit under larger ones. The amount of irrigable land bordering on this portion of canal is small, but after passing Newlon (30 miles from the headworks), the valley increases to a maximum width of about 5 miles. The main canal in the remainder of the work is located almost altogether in economic cut, with the exception of about 3 miles of sidehill work before crossing creeks. These crossings on the lower work are made by siphons, through which the canal flows under a head of about 25 feet. Culverts are also provided where necessary, and at suitable points near creeks it is proposed to build sluiceways and spillways for the regulation of the depth of water in canal.

Preliminary investigations of this project were made during the field season of 1904. The results of these investigations and a general description of the project are given under the heading "Fort Buford project" in the Third Annual Report of the Reclamation Service, second edition, pages 432-439, and in the Fourth Annual Report, pages 188-208.

The entire main canal and the lateral system for about 27,000 acres below Newlon, where the principal area of irrigable land is located, are now under construction. Plans and specifications have been prepared for the lateral system for 21,000 acres of land between the headworks and Newlon. In addition to irrigating the land below the canal on this part of the work, it is proposed to develop sufficient power from the canal to pump water to about 2,500 acres of bench land in the vicinity of Tokna, about 18 miles from the headworks.

A telephone system has been installed, and camp buildings and warehouses have been erected. Fairly good progress is now being made throughout the length of the 67 miles of main canal, except on division 3. Good progress is also being made on about 74 miles of laterals for the first 28,000 acres of the project to be irrigated. The unusual rainfall in May and June, 1906, 5.25 inches of rain having fallen during the last of May, and 9.8 inches during the month of June, delayed work considerably.

In the following table are listed the contracts entered into for building work on the Lower Yellowstone project. This list includes all contracts for excavation, embankment, masonry, and erection of structures, but does not include materials, such as cement, steel, timber, etc.

Contracts for building work on Lower Yellowstone project to June 30, 1906.

No. of contract.	Contractor.	Feature.	Estimated total value.[a]	Payments to June 30, 1906.	Per cent paid.
46	Widell-Finley Co. [b]	Canal, division 1	$163,368.00	$37,356.43	23
48	Chas. Stabern	Structure, divisions 1, 2, 3	104,276.00	20,436.53	20
49	Deadwood Construction Co.	Structure, division 4	28,143.00	8,153.34	29
50	E. A. Hess	Telephone	14,939.00	15,566.60	100
78a	John A. Nelson	Laterals	252,770.00	6,070.79	2
82	Noble & Mann	Lateral "N"	5,727.50	1,359.60	24
99	Henry C. De Laney	Main canal, division 4	88,091.00	7,096.41	8
106	D. H. Freeman & Co.	Main canal, division 2	251,516.00	17,321.15	7
109	John A. Nelson	Main canal, division 8	29,983.00	989.70	3
110	D. H. Freeman & Co.	Main canal, division 1	205,115.00	1,077.84	1

[a] For a discussion of advance estimates and final costs see p. 51.
[b] Contractor in default; work relet, now being done ay D. H. Freeman & Co.

MAIN CANAL AND LATERALS.

Contract for the earthwork on division 1, main canal, was executed with the Widell-Finley Company, of Mankato, Minn., on July 22, 1905, and this company had completed 29.2 per cent of its contract when operations were discontinued in February, 1906, on which date the company passed into the hands of a receiver. The contract was declared suspended on March 26, 1906, and the contractor's equipment was taken possession of by the Reclamation Service on March

29. Contractors were asked to submit bids for the completion of this work, and the proposals received are given below. The contract was reawarded to D. H. Freeman & Co. of St. Cloud, Minn. This firm immediately started work, and up to June 30, 1906, 0.5 per cent of the contract was completed. The plant of the Widell-Finley Company was turned over to D. H. Freeman & Co.

Bids received for completion of excavation on main canal, division 1, Lower Yellowstone project.

Item.	Quantity.	D. H. Freeman & Co., St. Cloud, Minn.		Billings Construction Co., Billings, Mont.	
		Unit price.	Amount.	Unit price.	Amount.
Excavation:					
Class 1 ... cubic yards..	800,000	$0.24	$192,000	$0.25	$200,000
Class 2 ... do....	1,000	.35	350	.40	400
Class 3 ... do....	1,000	.65	650	.60	600
Class 4 ... do....	1,000	1.60	1,600	1.75	1,750
Wet excavation in canal ... do....	20,000	.40	8,000	1.00	20,000
Overhaul ... do....	25,000	.01½	375	.01½	375
Terra-cotta pipe:					
24-inch ... linear feet..	120	3.50	420	4.50	540
30-inch ... do....	120	4.00	480	5.50	660
36-inch ... do....	120	4.50	540	6.50	780
Puddling ... cubic yards..	1,000	.70	700	1.25	1,250
Total			205,115		226,355

Contract for earthwork, divisions 2, 3, and 4, main canal, was entered into on July 21, 1905, with Callahan Bros., Phelan & Shirley, of Omaha, Nebr., at a very low price. As this company refused to go on with the work, their contract was suspended on February 28, 1906, the work was readvertised, and the following bids for divisions 2 and 4 were received on April 12, 1906.

Bids opened April 12, 1906, for divisions 2 and 4, main canal, Lower Yellowstone project.

[Specifications No. 81.]

DIVISION 2.

Item.	Quantity.	D. H. Freeman & Co., St. Cloud, Minn.		C. J. Murphy, Glendive, Mont.		H. C. DeLaney, Williston, N. Dak.	
		Unit price.	Amount.	Unit price.	Amount.	Unit price.	Amount.
Excavation:							
Class 1 ... cubic yards..	1,106,500	$0.22	$243,430.00				
Class 2 ... do....	1,300	.32	416.00				
Class 3 ... do....	1,200	60	720.00				
Class 4 ... do....	1,000	1.50	1,500.00				
Overhaul ... do....	150,000	.015	2,250.00				
Terra-cotta pipe, 24-inch . feet..	800	2.50	2,000.00				
Puddling ... cubic yards..	2,000	.60	1,200.00				
Total			251,516.00				

DIVISION 4.

Item.	Quantity.	D. H. Freeman & Co., St. Cloud, Minn.		C. J. Murphy, Glendive, Mont.		H. C. DeLaney, Williston, N. Dak.	
Excavation:							
Class 1 ... cubic yards..	463,200	$0.205	$94,956.00	$0.179	$82,912.80	$0.18	$83,376.00
Class 2 ... do....	800	.32	256.00	.30	240.00	.25	200.00
Class 3 ... do....	1,200	.60	720.00	.50	600.00	.45	540.00
Class 4 ... do....	100	1.50	150.00	1.50	150.00	1.50	150.00
Overhaul ... do....	85,000	.015	1,275.00	.015	1,275.00	.02	1,700.00
Terra-cotta pipe, 24-inch . . feet..	500	2.50	1,250.00	4.50	2,250.00	2.75	1,375.00
Puddling ... cubic yards..	1,000	.60	600.00	.75	750.00	.75	750.00
Total			99,207.00		88,177.80		88,091.00

The contract for division 2 was awarded to D. H. Freeman & Company, of St. Cloud, and satisfactory progress is being made, 7.7 per cent of the work having been completed June 30, 1906. The contract for division 4 was awarded to Henry C. De Laney, of Williston, N. Dak., who is making satisfactory progress. On June 30, 1906, 8.9 per cent of the work under the contract was completed.

As no bids were received for division 3, informal proposals were asked, and the contract for this work was awarded to Newman & Hoy, of St. Paul, Minn. An abstract of the bids received is given below:

Bids received for excavation on division 3, main canal, Lower Yellowstone project.

Work.	Bidder.	Item.	Quantity.	Price.	Amount.
4½ miles, station 818+40 to station 1056+00.	C. J. Murphy, Glendive, Mont.	Excavation:			
		Class 1..cubic yards..	509,250	$0 24	$122,220.00
		Class 2.........do....	650	.33	214.50
		Class 3.........do....	600	.60	360.00
		Class 4.........do....	500	1.50	750.00
		Overhaul..........do....	75,000	.01½	1,125.00
		24-inch T. C. pipe..lin ft..	400	4.00	1,600.00
		Puddling...cubic yards..	1,000	.75	750.00
		Total..............	....	......	127,019.50
4½ miles, station 1056+00 to station 1293+60.	Henry C. De Laney, Williston, N. Dak.	Excavation:			
		Class 1..cubic yards..	577,450	.24	138,588.00
		Class 2.........do....	550	.36	198.00
		Class 3.........do....	200	.60	120.00
		Class 4.........do....	100	1.50	150.00
		Overhaul..........do....	25,000	.02	500.00
		24-inch T. C. pipe..lin. ft..	500	3 50	1,750.00
		Puddling...cubic yards..	1,000	.80	800.00
		Total..............	....	......	142,106.00
2 miles, station 1056+00 to station 1161+60.	C. J. Murphy, Glendive, Mont.	Excavation:			
		Class 1..cubic yards..	313,000	.22	68,860.00
		Class 2.........do....	300	.30	90.00
		Class 3.........do....	200	.50	100.00
		Class 4.........do....	10	1.50	15.00
		Overhaul..........do....	25,000	.01½	375.00
		24-inch T. C. pipe..lin. ft..	300	4.00	1,200.00
		Puddling...cubic yards..	500	.75	375.00
		Total..............	....	......	71,015.00
3 miles, station 845+00 to station 1008+00.	.....do.............	Excavation:			
		Class 1..cubic yards..	166,500	.18	29,970.00
		Class 2.........do....	300	.25	75.00
		Class 3.........do....	200	.45	90.00
		Class 4.........do....	10	1.50	15.00
		Overhaul..........do....	60,000	.02	1,200.00
		24-inch T C. pipe..lin. ft..	200	2.75	550.00
		Puddling...cubic yards..	1,000	.75	750.00
		Total..............	....	......	32,650.00
Team work on entire division, 9 miles, station 818+40 to station 1293+60 and finishing, 3 miles, station 845+00 to station 1008+00.	.....do.............	Excavation:			
		Class 1..cubic yards..	575,000	.20	115,000.00
		Class 2.........do....	1,000	.30	300.00
		Class 3.........do....	700	.50	350.00
		Class 4.........do....	100	1.50	150.00
		Overhaul..........do....	100,000	.01½	1,500.00
		24-inch T. C. pipe..lin. ft..	900	4.00	3,600.00
		Puddling...cubic yards..	1,000	.75	750.00
		Total..............	....	......	121,650.00
All work on entire division, 9 miles, station 818+40 to station 1293+60.	Billings Construction Co., Billings, Mont.	Excavation:			
		Class 1..cubic yards..	1,086,700	.26	282,542.00
		Class 2.........do....	1,200	.40	480.00
		Class 3.........do....	800	.60	480.00
		Class 4.........do....	100	1.75	175.00
		Overhaul..........do....	100,000	.01½	1,500.00
		24-inch T. C. pipe..lin. ft..	900	4.50	4,050.00
		Puddling...cubic yards..	2,000	1.25	2,500.00
		Total..............	....	......	291,727.00

Bids received for excavation on division 3, main canal, Lower Yellowstone project—Continued.

Work.	Bidder.	Item.	Quantity.	Price.	Amount.
All work on entire division, 9 miles, station 818+40 to station 1293+60.	Newman and Hoy, St. Paul, Minn.	Excavation:			
		Class 1..cubic yards..	1,086,700	$0.22	$239,074.00
		Class 2..........do....	1,200	.32	384.00
		Class 3..........do....	800	.60	480.00
		Class 4..........do....	100	1.50	150.00
		Overhaul..........do....	100,000	.01½	1,500.00
		24-inch T.C. pipe..lin. ft..	900	2.50	2,250.00
		Puddling...cubic yards..	2,000	.60	1,200.00
		Total..................................			245,038.00

A contract was made July 24, 1905, with Charles Stabern, of Helena, Mont., for structures on divisions 1, 2, and 3, of main canal. At the end of June, 1906, the foundation and about half the concrete had been placed for the headworks, and excavation had been made for the Burns Creek conduit and Beef Slough culvert. Unsatisfactory progress has been made on this work. At the end of June, 68.7 per cent of the contract time had elapsed and only 25 per cent of the work was completed.

Contract was entered into on July 17, 1905, with the Deadwood Construction Company, of Deadwood, S. Dak., for the structures on division 4. Fair progress has been made and on June 30, 1906, 36.2 per cent of work was completed.

In December, 1905, two contracts were executed with the Widell-Finley Company for divisions 5 to 9 of the main canal, and laterals A to P, excepting N. This company went into the hands of a receiver before the work was commenced, and these contracts were re-awarded to John A. Nelson, of Minneapolis, Minn., at the same prices. The contractor is making fair progress, and on June 30 work was 3.1 per cent completed.

Contract for earthwork on lateral N was entered into with Nohle & Mann, of Buford, N. Dak., on December 16, 1905. They are making good progress. On June 30, 1906, 29.9 per cent of their work was completed.

Proposals for structures on divisions 5 to 9 and laterals A to P were to have been opened April 12, 1906, but none were received; in fact, no contractors came to look over the work with a view to submitting prices. Mr. James Munn, of the Deadwood Construction Company, which has contract for division 4, schedule B, submitted proposal for this work, and contract was awarded to him. The contract prices for this work are given in the following table:

Contract prices, structures, divisions 5 to 9, and lateral A to P, Lower Yellowstone project.

Work or material.	Quantity.	Unit price.	Amount.
Excavation:			
Class 1....................................	28,000 cubic yards..........	$0.30	$8,400.00
Class 2....................................	1,000 cubic yards..........	.65	650.00
Class 3....................................	.....do..........................	.75	750.00
Class 4....................................	100 cubic yards..............	1.00	100.00
Wet excavation..............................	28,700 cubic yards..........	1.00	28,700.00
Excavation in narrow trenches...........	2,000 cubic yards..........	.65	1,300.00
Overhaul.....................................	5,000 cubic yards..........	.015	75.00
Puddling.....................................	18,000 cubic yards..........	.75	13,500.00
Riprap..	6,700 cubic yards..........	3.00	20,100.00

Contract prices, structures, divisions 5 to 9, and lateral A to P, Lower Yellowstone project—Continued.

Work or material.	Quantity.	Unit Price.	Amount.
Concrete:			
Class 1	1,500 cubic yards	$9.00	$13,500.00
Class 2	5,000 cubic yards	8.00	40,000.00
Class 3	800 cubic yards	7.75	6,200.00
Square steel bars for concrete reinforcement:			
½-inch	43,500 pounds	.06	2,610.00
¾-inch	508,500 pounds	.06	30,510.00
1-inch	1,700 pounds	.06	102.00
Gravel filling	1,500 cubic yards	1.25	1,875.00
Placing gates at turnouts and sluiceways	55,000 pounds	.02	1,100.00
Furnishing and placing 12-inch by 12-foot posts	60	7.00	420.00
Sheet piles:			
Delivered	77,100 feet B. M	[a] 50.00	3,855.00
Driven	15,700 linear feet	.25	3,925.00
Cast iron	2,140 pounds	.10	214.00
Structural steel (grating bars and valve-stem pipes)	2,785 pounds	.10	278.50
Gate valves:			
6-inch	5	40.00	200.00
8-inch	2	50.00	100.00
Terra cotta pipe:			
8-inch, 8-foot cut or less	2,800 linear feet	1.25	3,500.00
8-inch, 8-foot to 14-foot cut	1,900 linear feet	1.75	3,325.00
8-inch, 14-foot cut or more	100 linear feet	2.50	250.00
10-inch, 8-foot cut or less	1,300 linear feet	1.50	1,950.00
10-inch, 8-foot to 14-foot cut	600 linear feet	2.00	1,200.00
10-inch, 14-foot cut or more	100 linear feet	2.75	275.00
12-inch at turn-outs	160 linear feet	1.25	200.00
24-inch, 8-foot cut or less	600 linear feet	3.00	1,800.00
24-inch, 8-foot to 12-foot cut	500 linear feet	3.75	1,875.00
Lumber:			
Class 1, S1S1E	252,000 feet B. M	50.00	12,600.00
Class 2	9,000 feet B. M	50.00	450.00
Total			205,814.50

[a] M feet B. M.

DIVERSION DAM.

Plans and specifications for the diversion dam at the intake of the main canal were prepared and bids were opened on December 5, 1905. This dam will be located about 18 miles northeast of Glendive, Mont. It will be a timber-cribbed structure about 12 feet high and will raise low water in the river about 5 feet. The following bids were received on December 5, 1905:

Bids opened December 5, 1905, for diversion dam, Lower Yellowstone project.

[Specifications No. 57.]

Kind of work.		Quantity.	Walter D. Lovell, Minneapolis, Minn.		Charles Stalbern, Helena, Mont.	
			Unit price.	Amount.	Unit price.	Amount.
Piles delivered	linear feet	12,600	$0.43	$5,418.00	$0.75	$9,450.00
Piles driven	do	10,000	.40	4,000.00	.25	2,500.00
Sheet piles delivered	feet B. M.	175,000	[a] 42.00	7,350.00	[a] 80.00	14,000.00
Sheet piles driven	linear feet	26,000	.50	13,000.00	.25	6,500.00
Excavation, wet	cubic yards	3,500	3.83	13,405.00	2.50	8,750.00
Excavation, dry	do	500	1.00	500.00	.50	250.00
Rock and gravel filling	do	5,200	5.00	26,000.00	6.00	31,200.00
Rock in apron	do	2,000	5.00	10,000.00	6.00	12,000.00
Lumber in place	feet B. M.	550,000	[a] 52.00	28,600.00	[a] 50.00	27,500.00
Bolts and spikes in place	pounds	85,000	.08¾	7,437.50	.10	8,500.00
Guard rails in place	tons	65	140.00	9,100.00	100.00	6,500.00
Concrete	cubic yards	220	6.50	1,430.00	7.00	1,540.00
Placing steel for concrete reenforcement	pounds	22,000	.03½	770.00	.01	220.00
Refilling	cubic yards	1,500	.75	1,125.00	1.00	1,500.00
Riprap	do	4,500	5.00	22,500.00	6.25	28,125.00
Total				150,635.50		158,535.00

[a] M feet B.M.

All the bids received on December 5 were rejected because they were considered too high, and the work was again advertised. Proposals were opened on May 10, 1906, and the contract was awarded to the lowest bidder, the Campbell-Ferrier Company of Duluth, Minn. As this company was unable to furnish satisfactory bond, the work was awarded to the next lowest bidders—Newman & Hoy, of St. Paul, Minn.

Bids opened May 10, 1906, for diversion dam, Lower Yellowstone project.

[Specifications No. 83.]

Work or material.	Quantity.	Campbell-Ferrier Co., Duluth, Minn.		Newman & Hoy, St. Paul, Minn.	
		Unit price.	Amount.	Unit price.	Amount.
Piles delivered......................linear feet..	12,600	$0.30	$3,780.00	$0.35	$4,410.00
Piles driven.................................do....	10,000	.37	3,700.00	.30	3,000.00
Sheet piles delivered.................feet B. M..	175,000	[a] 35.00	6,125.00	[a] 50.00	8,750.00
Sheet piles driven ....linear feet..	26,000	.30	7,800.00	.25	6,500.00
Excavation, wet..................cubic yards..	3,500	3.00	10,500.00	5.00	17,500.00
Excavation, dry..........................do....	500	1.25	625.00	1.00	500.00
Rock and gravel filling....................do....	5,200	3.50	18,200.00	4.00	20,800.00
Rock in apron.............................do....	2,000	5.00	10,000.00	5.00	10,000.00
Lumber in place ....feet B. M..	550,000	[a] 48.00	26,400.00	[a] 50.00	27,500.00
Bolts and spikes in place..............pounds..	85,000	.07½	6,375.00	.08	6,800.00
1 x 4 inch flat bars in place ....tons..	48	90.00	4,320.00	95.00	4,560.00
Concrete..........................cubic yards..	220	9.50	2,090.00	6.50	1,430.00
Placing steel for concrete reenforcement, pounds	22,000	.07	1,540.00	.00¾	165.00
Refilling...........................cubic yards ..	1,500	1.25	1,875.00	1.00	1,500.00
Riprap ....do....	4,500	4.75	21,375.00	4.50	20,250.00
Total	....	....	124,705.00	....	133,665.00

Work or material.	Quantity.	Pacific Coast Construction Company, Portland, Oreg.		Hughes & Olson, Butte, Mont.	
		Unit price.	Amount.	Unit price.	Amount.
Piles delivered.......................linear feet..	12,600	$0.45	$5,670.00	$0.48	$6,048.00
Piles driven ....do....	10,000	.15	1,500.00	.45	4,500.00
Sheet piles delivered.................feet B. M..	175,000	[a] 55.00	9,625.00	[a] 50.00	8,750.00
Sheet piles driven...................linear feet..	26,000	.15	3,900.00	.45	11,700.00
Excavation, wet ....cubic yards..	3,500	6.00	21,000.00	8.50	29,750.00
Excavation, dry..........................do....	500	.50	250.00	1.00	500.00
Rock and gravel filling....................do....	5,200	4.00	20,800.00	4.50	23,400.00
Rock in apron.............................do....	2,000	7.00	14,000.00	4.50	9,000.00
Lumber in place.........................feet B. M..	550,000	[a] 55.00	30,250.00	[a] 50.00	27,500.00
Bolts and spikes in place..............pounds..	85,000	.06	5,100.00	.10	8,500.00
1 x 4 inch flat bars in place................tons..	48	140.00	6,720.00	140.00	6,720.00
Concrete..........................cubic yards ..	220	10.00	2,200.00	10.00	2,200.00
Placing steel for concrete reenforcement, pounds	22,000	.03	660.00	.05	1,100.00
Refilling ....cubic yards..	1,500	.60	900.00	.60	900.00
Riprap ....do....	4,500	4.50	20,250.00	3.00	13,500.00
Total..	....	....	142,825.00	....	154,068.00

[a] M feet B. M.

TELEPHONE LINE AND CEMENT.

Contract was executed with Elmer A. Hess, of Lyons, Iowa, June 28, 1905, for about 74 miles of telephone line. This work was completed early in December of 1905 at a total cost of $15,556.60.

On June 30, 1906, the Illinois Steel Company, of Chicago, had delivered 52.7 per cent of the cement contracted for in August, 1905. On April 12, 1906, proposals were received for furnishing from 8,000 to 12,500 barrels of cement for use in structures on last 33 miles of canal and laterals. Only one bid was received, that of the Illinois

Steel Company, at $1.60 per barrel f. o. b., South Chicago, Ill. On April 23, 1906, another contract was made with the Illinois Steel Company for supplying this cement. No cement has yet been delivered under the latter contract.

STEEL.

No bids having been received on August 21, 1905, for furnishing 600,000 pounds of square steel bars for reenforcement of concrete, and an exigency existing which would not admit of delay, authority was granted by the Secretary of the Interior to purchase same in open market at a price not to exceed 2 cents per pound. Pursuant to this authority, approximately 60 tons of steel were purchased from the Inland Steel Company of Chicago, at $1.65 per hundred, and 53 tons from the Carnegie Steel Company, of Chicago, at $1.51½ a hundred. On March 12, 1906, proposals were received for furnishing 427,000 pounds of square steel bars for reenforcement of concrete. John B. Kendall, of Washington, D. C., was the lowest bidder, and was awarded the contract.

Bids opened March 12, 1906, for steel for reenforcement of concrete, Lower Yellowstone project.

Item.	Quantity.	John Blake Kendall, Washington, D. C.[a]		St. Louis Exposition Fire Proofing Co., St. Louis, Mo.		Crucible Steel Co., Pittsburg, Pa.	
		Unit price.	Amount.	Unit price.	Amount.	Unit price.	Amount.
	Pounds.						
Bars, square, ½-inch	8,700	$0.016	$139.20	$0.018	$156.60	$0.01725	$150.08
Bars, square, ¾-inch	393,000	0.016	6,288.00	0.017	6,681.00	0.01725	6,779.25
Bars, square, 1-inch	16,450	0.016	263.20	0.017	279.65	0.01725	283.76
Bars, square, 1¼-inches	8,940	0.016	143.04	0.017	151.98	0.01725	154.22
Total			6,833.44		7,269.23		7,367.31
Place of delivery stated in bidder's proposal.		Pittsburg, Pa.		Youngstown, Ohio.		Pittsburg, Pa.	

Item.	Quantity.	Belmont Iron Works, Philadelphia, Pa.		Illinois Steel Co., Chicago, Ill.[b]		Charles K. Barnes & Co., Philadelphia, Pa.[b]	
		Unit price.	Amount.	Unit price.	Amount.	Unit price.	Amount.
	Pounds.						
Bars, square, ½-inch	8,700	$0.02	$174.00	$0.016	$139.20	[c] $0.01775 [d] 0.01825	$154.43 158.78
Bars, square, ¾-inch	393,000	0.02	7,860.00	0.015	5,895.00	[c] 0.01775 [d] 0.01825	6,975.75 7,172.25
Bars, square, 1-inch	16,450	0.02	329.00	0.015	246.75	[c] 0.01775 [d] 0.01825	291.99 300.21
Bars. square, 1¼-inch	8,940	0.02	178.80	0.015	134.10	[c] 0.01775 [d] 0.01825	158.69 163.16
Total			8,541.80		6,415.05		[c]7,580.86 [d]7,794.40
Place of delivery stated in bidder's proposal.		Philadelphia or Pittsburg, Pa.		Milwaukee, Wis.		Franklin, Pa.	

[a] Lowest formal bid.
[b] Bid informal.
[c] Plain square bar.
[d] Twisted square bar.

SLUICE GATES.

A contract was made with the Chapman Valve Manufacturing Company, Indian Orchard, Mass., for furnishing eleven 5-foot circular sluice gates for use at the headworks. A circular advertisement was sent to the principal dealers and the contract was awarded to the lowest bidder. The bids received were as follows:

Chapman Valve Manufacturing Company, Indian Orchard, Mass., $800 each, f. o. b., Glendive, Mont.

Coffin Valve Company, Boston, Mass., $900 each, f. o. b., Glendive, Mont.

The advertisement was sent also to the Pittsburg Manufacturing Company, Pittsburg, Pa., and to R. D. Wood & Co., Philadelphia, Pa., but no bids were received from these companies.

IRRIGABLE LANDS.

During the winter of 1905–06 a part of the public lands under the project was resurveyed, and all missing section corners reset, and the acreage determined in each land subdivision. The remainder of the public land will be resurveyed during the winter of 1906–7. Other surveys on the project are now completed except those incidental to construction of the works. The distribution of the irrigable lands is shown by the following table:

Lands under Lower Yellowstone project.

	Acres.	Percentages.
GENERAL.		
Total	77,697	....
Private	40,693	52
Public	25,889	33
State	2,797	4
Railroad	8,318	11
Irrigable	66,881	86
Nonirrigable	10,816	14
PRIVATE.		
Total	40,693	....
Irrigable	39,236	96
Nonirrigable	1,457	4
PUBLIC.		
Total	25,889	....
Irrigable	19,551	75
Nonirrigable	6,388	25
STATE.		
Total	2,797	....
Irrigable	2,510	90
Nonirrigable	287	10
RAILROAD.		
Total	8,318	....
Irrigable	5,584	67
Nonirrigable	2,734	33
IRRIGABLE.		
Total	66,881	....
In Montana (Dawson County)	45,750	68
In North Dakota (McKenzie County)	21,131	32
North of Newlon, Mont	46,967	70
South of Newlon, Mont	19,914	30
Requiring pumping	2,500	4
Private	39,236	59
Public	19,551	29
State	2,510	4
IRRIGABLE—continued.		
Railroad	5,584	8
Subscribed (private). See below.		
Unsubscribed (private). See below.		
NONIRRIGABLE.		
Total	10,816	....
Land above canal line, but included in unit farms for pasture purposes	6,059	56
Land below Canal Line	4,757	44
Private	1,45.	13
Public	6,338	59
State	287	3
Railroad	2,734	25
In Montana (Dawson County)	8,322	77
In North Dakota (McKenzie County)	2,494	23
IN MONTANA (DAWSON COUNTY.)		
Total	54,072	....
Private	27,463	51
Public	15,990	30
State	2,297	4
Railroad	8,318	15
Irrigable	45,750	85
Nonirrigable	8,322	15
IN NORTH DAKOTA (M'KENZIE COUNTY).		
Total	23,625	....
Private	13,230	56
Public	9,895	42
State	500	2
Railroad	....	....
Irrigable	21,131	89
Nonirrigable	2,494	11

EXPENDITURES.

The expenditures on the Lower Yellowstone project are summarized in the following tables:

Expenditures, according to physical features, on Lower Yellowstone project to June 30, 1906.

Features.	Engineering and administration.	Building.
Incidental structures:		
Telephone line	$1,210.99	$18,260.93
Headquarters—		
Office, cottage, lodging and boarding house, warehouses, stables, corrals, etc	504.58	1,295.73 3,495.52 2,591.75
Other offices, lodging and boarding houses, stables, etc	302.74	4,280.42
Irrigation structures:		
Lower Yellowstone headworks	10,091.56	39,603.25
Other structures	4,036.62	16,850.00
Main canal	22,201.41	86,992.01
Distributing system	2,018.31	3,020.00
Irrigable lands:		
Farm unit subdivision and soil examination	3.298.31	
Examination of project as a whole	25,596.93	
Administration of project as a whole	16,807.61	
Total	86,069.06	176,389.61
Grand total	....	262,458.67

Expenditures, according to purpose and nature, on Lower Yellowstone project to June 30, 1906.

[Total, $262,458.67.]

	Services.	Traveling.	Subsistence.	Equipment.	Materials.	Supplies.	Rent and storage.	Forage.	Job work.
Engineering:									
Examination	$13,412.11	$5,672.73	$1,742.00	$3,832.52	....	$428.70	$7.61	$501.26	....
Survey and inspection	18,416.31	2,087.73	4,176.89	6,316.41	....	1,742.31	13.78	1,484.11	....
Design	5,771.22	71.42	7.00	210.96	....	46.96	21.11	....	....
Subdivision	2,825.58	128.83	13.00	....	....	325.88	1.27	3.75	....
Building:									
Rights and property	164.67	50.50	29.00	....	....	50.20	....	6.15	....
Building	33,569.66	1,723.94	10,236.70	5,065.51	$24,345.78	4,574.60	160.00	3,689.86	$92,723.04
Administration	12,326.21	1,209.21	36.50	823.05	....	2,284.06	116.08	12.50	....

OKLAHOMA.

The western part of Oklahoma is a region of uncertain rainfall. During ordinary years the precipitation, if properly distributed, would be ample for excellent crops. In some years it is properly distributed, while in others the crops are lost for lack of rain at the time that it is needed.

Recognizing that such a region needs irrigation, if it can be had at a reasonable cost, extensive reconnaissance surveys have been made on all the streams in this semiarid region during several past seasons, and stream measurements for determining the available water supply have been pushed rapidly since April, 1905.

Surveys and examinations have been made of every possible site for an irrigation project on Cimarron and Canadian rivers, Beaver Creek, Wolf Creek, Washita River, and Red River, and their tributaries. With the exception of the main Cimarron River above Garrett, the North Fork of Red River at points near Snyder and Lugert, and Otter Creek near Mountain Park, these streams may be generally described as occupying sandy valleys of practically uniform slope and width, with no narrow places where dams can be economically constructed of stone or earth, as there is no bed rock for base and abutments of dams, and no suitable rock for masonry or concrete.

All of the streams are very irregular in flow, being practically dry at certain seasons, deficient in volume ordinarily, and subject to violent floods of short duration at irregular intervals. Such streams can not be utilized for irrigation on a large scale without ample storage, and the conditions for storage do not exist, except at the points mentioned. The largest and best site that has been found is on North Fork of Red River, in Greer and Kiowa counties, near the towns of Headrick and Snyder, and is known as the Navajo reservoir site. Extensive surveys and estimates have been made there to determine the feasibility of an irrigation project.

Previous work in this area is described in the second, third, and fourth annual reports. During the fiscal year ending June 30, 1906, surveys, examinations, plans, and estimates have been made with reference to the proposed project on Red River. Plane-table surveys and a contour map of the Navajo storage reservoir have been made, and surveys, contour map, and diamond-drill borings have been made at the Navajo dam site, as well as at the dam site near Lugert, farther upstream. Topographic surveys have been carried on in the vicinity of Salt Springs on the Elm Fork, and survey has been made of a canal line diverting the low-water flow of Elm Fork in order to eliminate part of the salt water of this stream from the system. Canal surveys have been made for distributing the water to 30,000 acres in Greer County and 30,000 acres in Kiowa County; and an alternative canal system has been surveyed for irrigating 30,000 acres in Kiowa County and 70,000 acres in Comanche County. A considerable amount of plane-table work has been done on the irrigable lands, preliminary examination has been made of the soil, systematic sampling and analysis of the water supply has been carried on, and reliable stream measurements have been kept up. An experimental irrigation plant has also been installed in which water pumped from Red River will be used on different crops to determine the practicability of its use and the duty of water in this region.

A summary of the field work in Oklahoma from 1902 to date includes over 1,000 miles of reconnaissance, 800 miles of transit survey, and 470 miles of level survey, 3,251 feet of diamond-drill borings, systematic stream measurements, analysis of water samples, expert soil and underground water examinations, and the installation of an experimental irrigation system of 200 acres, with pumping plant and 8 miles of canal.

The building of a dam across the North Fork of Red River at the Navajo dam site would form a reservoir with a storage capacity of over 200,000 acre-feet. The reservoir will submerge about 12,000 acres. including the following lands in private ownership:

Private lands in Navajo reservoir site.

	Acres.
First-class lands	530
Second-class lands	7,000
Third-class lands	3,000

The unsolved problems with regard to this project are the quantity of water available, the duty of water, and the practicability of using water of the quality procurable.

Prior to the calendar year 1905 very little systematic hydrographic work had been done in this region. Since the early part of that year reliable stream measurements have been made, and the discharge at Headrick and Snyder, on the North Fork of Red River near the Navajo dam site, and on tributaries entering above has been estimated. The estimated monthly discharge of the river at the Navajo dam site, or the amount of water that would have been available for storage in the proposed reservoir, is as follows:

Discharge of North Fork of Red River at Navajo dam site.

1905.	Acre-feet.
January	[a] 7,560
February	[a] 25,500
March	[a] 28,186
April	[a] 58,989
May	[a] 145,043
June	[a] 47,515
July	10,691
August	26,560
September	17,380
October	1,758
November	14,940
December	10,760
Total	394,882
1906.	
January	8,579
February	5,282
March	2,584
April	29,205
May	47,017
June	34,096
Total for six months, 1906	126,763

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[a] January 1 to April 13 estimated by taking the discharges at Granite and Hobart for this period in 1905 and adding thereto the discharge at Mangum on Elm Fork for the corresponding period of 1906.

The first lands proposed for irrigation were 30,000 acres in Greer County and 30,000 in Kiowa County. It was found that the Greer County lands were a tight clay soil that would be hard to drain, and later surveys were made for irrigating a large body of sandy land in Comanche County. All of the lands that have been considered in this project are level and exceeding fertile, and the quantity is greater than the water supply can possibly serve.

As both the river water and the underground water contain large quantities of sodium chloride and other solids, an investigation is being made to determine the possibility of eliminating part of these ingredients. It is possible that satisfactory plans for this purpose can be made.

In April, 1906, a 16-horsepower Stover gasoline engine and a 6-inch Byron-Jackson centrifugal pump were purchased for pumping water from Red River and carrying on experimental irrigation. The San Francisco earthquake delayed the shipment of the pump and it was not delivered at Snyder, Okla., until June. This made little difference, however, as rains were frequent and copious during the whole spring and no irrigation was needed. The pump and engine were properly set and put to work. The lift is 21 feet and the discharge is 1,150 gallons per minute. The ditches are 8 miles in length and can furnish water to 200 acres.

The expenditures are summarized in the following table:

Expenditures, according to purpose and nature, in Oklahoma to June 30, 1906.

[Total, $45,873.31.]

	Services.	Traveling.	Subsistence.	Equipment.	Materials.	Supplies.	Rent and storage.	Forage.
Engineering:								
Examination	$25,154.40	$5,406.93	$4,732.50	$2,105.93	$139.39	$1,727.96	$13.14	$440.03
Survey	555.17	137.94	24.13	1,212.09	....	101.89	....	....
Design	70.00	....	....	....	....	....	....	....
Subdivision	40.42	....	....	....	....	....	....	....
Administration	3,238.11	252.96	94.81	151.68	....	246.72	10.00	17.11

OREGON.

UMATILLA PROJECT.

The Umatilla project includes lands bordering Columbia River near the mouth of Umatilla River. This project is divided by Umatilla River into an East division and a West division. The lands of the East division will be irrigated by water from Umatilla River and those of the West division will obtain water from John Day River by a gravity system or from Columbia River by a pumping plant. The East division is referred to in the Fourth Annual Report as the East Umatilla project.

EAST DIVISION.

GENERAL STATEMENT.

The principal data relating to the East division of the Umatilla project are summarized below:

Summary of principal data relating to Umatilla project (east division).

County: Umatilla.
Latitude: 45° 50′ +.
Longitude: 119° 10′.
Townships: 4 to 5 north, range 28 to 29 east, W. M.
Irrigable area: 20,000 acres.
Watershed area: 2,200 square miles.
Average rainfall: 9 inches.
Estimated run-off of Umatilla River at diversion: 600,000 acre-feet.
Range of temperature: Maximum 115°, minimum 5°.
Average elevation: 500 feet above sea level.
Principal products: Grain, vegetables, fruit.
Nearest railroad: Oregon Railroad and Navigation Company.
Nearest station: Hermiston, 6 miles; Echo, 10 miles; Umatilla, 10 miles; Cold Springs, 5 miles from reservoir.
Principal markets: Portland, 185 miles; Spokane, 246 miles.
Per cent public land: Alternate sections patented to Oregon Railroad and Navigation Company.
Kind of headworks: Low diversion dam just above Echo.
Reservoir area: 1,700 acres.
Capacity of reservoir: 50,000 acre-feet.
Duty of water: 2.8 acre-feet delivered.
Height of dam: 89 feet.
Length of main dam: 3,400 feet.
Type of dam: Earth fill.
Length of feed canal: 25 miles.
Length of main distributing canals: 12 miles.
Length of laterals: 128 miles.
Character of soil: Light sandy.
Value of irrigated land: $150 to $250.
Beginning of survey, present project: Spring of 1905.
Date of completion of project: Spring of 1908.

Detailed investigations have demonstrated the feasibility of this division (Pl. LXXIV), and an allotment of $1,000,000 was made on December 4, 1905.

The records of precipitation show an average annual rainfall of less than 9 inches at Umatilla. The plans provide for 4.25 acre-feet diverted from the river for each acre to be irrigated, and it is estimated that 2.8 acre-feet of this can be delivered after the lands and canals have become thoroughly wetted and silted up, or by the time the entire area of 20,000 acres is all under cultivation.

Weather Bureau records show an average of nearly seven months between killing frosts. The winters are usually mild and open and the summers hot, the winter temperature rarely falling below zero and then but for a few days, and the summer temperature occasionally reaching 115°.

Columbia River, soon to be open to navigation to Portland and the coast without transfer, is but 4 miles from the center of the area to be irrigated, and transcontinental railways pass through and along two sides of the project.

Later surveys have not materially modified the outline of the project as given in the last annual report. Water will be taken from Umatilla River by a diversion dam (Pl. LXXV) and carried through a feed canal to a reservoir that will be formed by building the Cold Springs dam. A party has been in the field continuously, mapping the irrigable lands, determining the character of foundations, and locating the feed-canal line.

FEED CANAL.

The feed canal (Pl. LXXVI) will head on Umatilla River about 1½ miles above the town of Echo, and will be 25 miles long. It will have a capacity of 300 second-feet at diversion. All structures will be of concrete. The following bids were opened on June 29, 1906:

Bids opened June 29, 1906, for storage feed canal, Umatilla project.

(Specifications No. 92.)

Work or material.	Quantity.	Pacific Coast Construction Co., Portland, Oreg.		Puget Sound Bridge and Dredging Co., Seattle, Wash.[a]		Lind, Meister & Grant, Portland, Oreg.	
		Unit price.	Amount.	Unit price.	Amount.	Unit price.	Amount.
Schedule 1.							
Excavation:							
Class 1.......cubic yards..	333,700	$0.18	$60,066.00	$0.15	$50,055.00	....	....
Class 2...............do....	48,400	.65	3,146.00	.45	21,780.00	....	....
Class 3...............do....	5,920	1.50	8,880.00	2.00	11,840.00	....	....
For structures ......do....	2,500	3.50	8,750.00	.60	1,500.00	....	....
Concrete:							
Class A...............do....	925	14.00	12,950.00	5.50	5,087.50	....	....
Class B...............do....	1,215	20.00	24,300.00	6.00	7,290.00	....	....
Riprap...................do....	3,600	2.50	9,000.00	3.00	10,800.00	....	....
Rock fill.................do....	1,000	1.75	1,750.00	1.50	1,500.00	....	....
Lumber ....M feet B. M..	92	55.00	5,060.00	32.00	2,944.00	....	....
Total..........................	....	....	162,216.00	....	112,796.50	....	....
Schedule 2.							
Excavation:							
Class 1.......cubic yards..	315,800	.17	53,686.00	.14	44,212.00	$0.19	$60,002.00
Class 2...............do....	5,000	.50	2,500.00	.45	2,250.00	.65	3,250.00
Class 3...............do....	200	1.25	250.00	2.00	400.00	1.50	300.00
For structures ......do....	800	3.50	2,800.00	.50	400.00	.75	600.00
Concrete:							
Class A.......cubic yards..	65	16.00	1,040.00	7.50	487.50	7.00	455.00
Class B...............do....	85	20.00	1,700.00	8.50	722.50	9.00	765.00
Riprap...................do....	40	2.50	100.00	3.00	120.00	2.00	80.00
Total..........................	....	....	62,076.00	....	48,592.00	....	65,452.00

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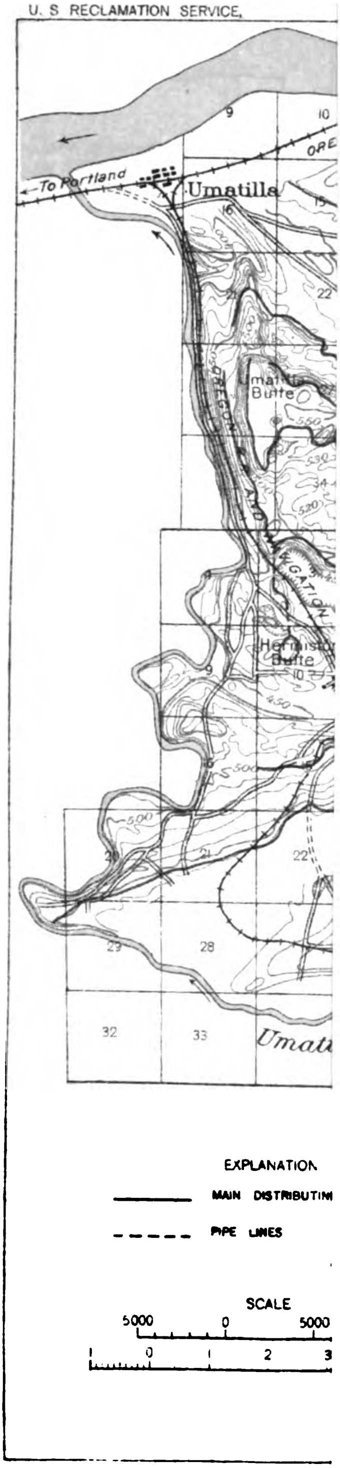
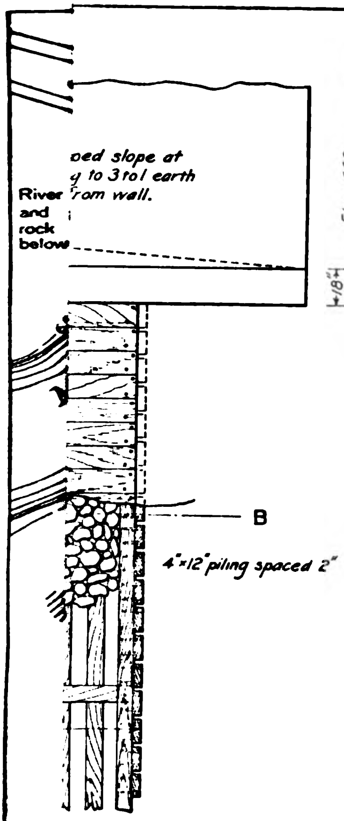
[a] Puget Sound Bridge and Dredging Co. will not accept schedule 1 without schedule 2, and will not accept schedule 2 without schedule 1.

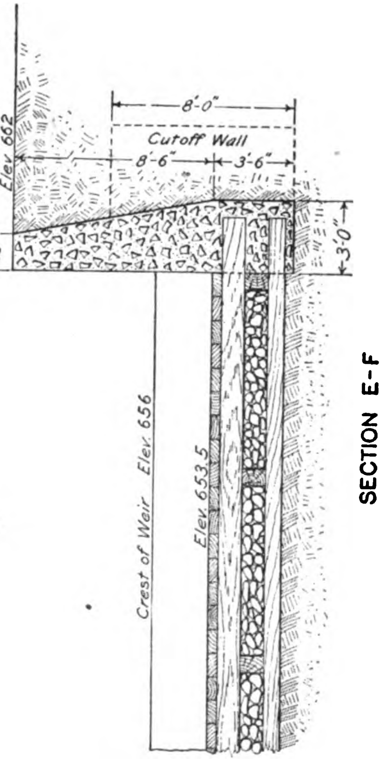
U. S. RECLAMATION SERVICE.



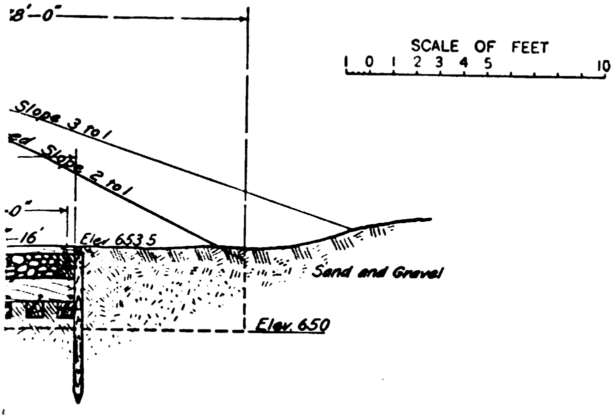
GENE



oed slope at
y to 3 to l earth
'rom wall.
River
and
rock
below
B
4"×12" piling spaced 2"

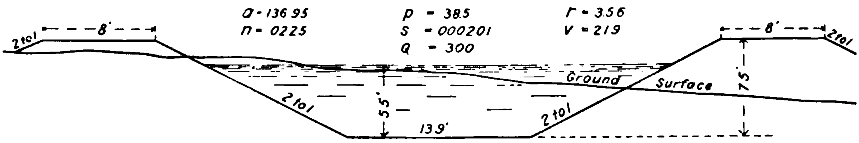


8'-0"
Cutoff Wall
Elev. 662
8'-6"
3'-6"
18"
3'-0"
Crest of Weir Elev. 656
Elev. 653.5
SECTION E-F

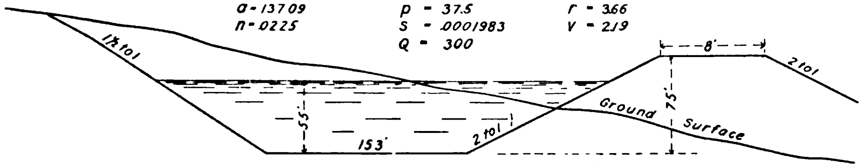


8'-0"
SCALE OF FEET
1 0 1 2 3 4 5 10
Slope 3 to l
ed Slope 2 to l
-0"
-16'
Elev 653.5
Sand and Gravel
Elev. 650

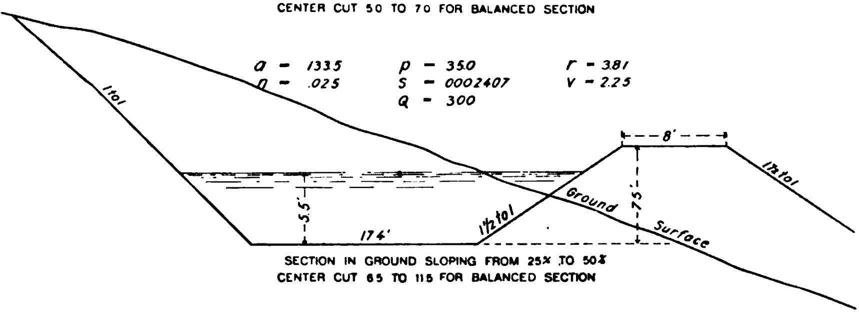
8653



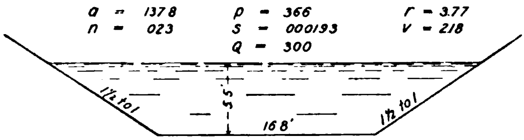
SECTION IN LEVEL GROUND AND IN SLOPES UP TO 12%
CENTER CUT 4.2 TO 5.0 FOR BALANCED SECTION



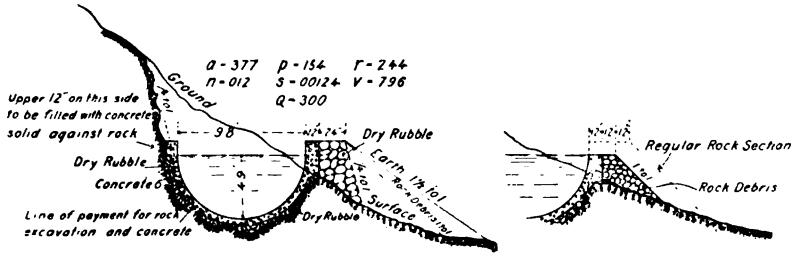
SECTION IN GROUND SLOPING FROM 12% TO 25%
CENTER CUT 5.0 TO 7.0 FOR BALANCED SECTION



SECTION IN GROUND SLOPING FROM 25% TO 50%
CENTER CUT 6.5 TO 11.5 FOR BALANCED SECTION



SECTION IN CUT



SECTION IN ROCK

SPILLWAY SECTION

CROSS SECTIONS OF STORAGE FEED CANAL, UMATILLA PROJECT, OREGON.

Bids opened June 29, 1906, for storage feed canal, Umatilla project—Continued.

Work or material.	Quantity.	Newport Land and Construction Co., Echo, Oreg.		William Stanley & Co., Seattle, Wash.		H. D. Page, Salt Lake City, Utah.	
		Unit price.	Amount.	Unit price.	Amount.	Unit price.	Amount.
Schedule 1.							
Excavation:							
Class 1.......cubic yards..	333,700	....	....	$0.275	$91,767.50	$0.23	$76,751.00
Class 2..............do....	48,400	....	....	1.10	53,240.00	.80	38,720.00
Class 3..............do....	5.920	....	....	3.10	18,352.00	1.60	9.472.00
For structures ......do....	2,500	....	....	1.50	3,750.00	.75	1,875.00
Concrete:							
Class A.......cubic yards..	925	....	....	15.25	14,106.25	10.00	9,250.00
Class B..............do....	1,215	....	....	22.70	27,850.50	11.00	13,365.00
Riprap..................do....	3,600	....	....	2.25	8,100.00	2.50	9,000.00
Rock fill.................do....	1,000	....	....	1.75	1,750.00	2.00	2,000.00
Lumber ....M feet B. M..	92	....	....	35.00	3,220.00	60.00	5,520.00
Total....................	....	....	....	....	221,866.25	....	165,953.00
Schedule 2.							
Excavation:							
Class 1.......cubic yards..	315,800	$0.16¼	$51,317.50	.275	86,845.00	.21	66,318.00
Class 2..............do....	5,000	.44	2,200.00	1.00	5,000.00	.75	3,750.00
Class 3..............do....	200	.95	190.00	3.00	600.00	1.50	300.00
For structures.......do....	800	.30	240.00	1.00	800.00	.50	400.00
Concrete:							
Class A.......cubic yards..	65	7.50	487.50	17.50	1,137.50	10.00	650.00
Class B..............do....	85	6.75	573.75	24.50	2,082.50	11.00	935.00
Riprap..................do....	40	1.50	60.00	3.00	120.00	2.50	100.00
Total....................	....	....	55,068.75	....	96,585.00	....	72,453.00

COLD SPRINGS DAM.

The dam (Pls. LXXVII and LXXVIII) will be an earth and gravel structure 90 feet high over lowest point of the natural surface. The dam will be approximately 600 feet long over the deeper portion, but it will have a total crest length of 3,400 feet. The capacity of the reservoir will be 50,000 acre-feet.

The following bids for the Cold Springs dam were opened June 28:

Bids opened June 28, 1906, for Cold Springs dam, Umatilla project.

[Specifications No. 90.]

Work and material.	Quantity.	Sweeney & Holmes, Portland, Oreg.		Puget Sound Bridge and Dredging Co., Seattle, Wash.	
		Unit price.	Amount.	Unit price.	Amount.
Excavation for dam:					
Earth........................cubic yards..	158,000	$0.31	$48,980.00	$0.4185	$66,123.00
Gravel..............................do....	455,000	.45	204,750.00	.4185	190,417.50
Excavation for trenches:					
Class 1..............................do....	61,300	.40	24,520.00	.6885	42,205.05
Class 2..............................do....	19,300	.60	11,580.00	1.5300	29,529.00
Class 3..............................do....	3,100	1.25	3,875.00	2.7000	8,370.00
Riprap:					
Alternative bid A...................do....	12,000	2.00	24,000.00	3.3750	40,500.00
Inlet and outlet and other work.....do....	80	2.00	160.00	3.3750	270.00
Rock fill:					
Alternative bid A...................do....	8,000	1.50	12,000.00	2.7000	21,600.00
Alternative bid B...................do....	28,500	1.50	42,750.00	2.7000	76,950.00
Rock fill ....do....	10,800	1.50	16,200.00	2.7000	29,160.00
Drain pipe:					
6-inch ....linear feet..	1,900	.50	950.00	.6750	1,282.50
8-inch..............................do....	600	.60	360.00	1.0000	600.00
Cement joints, 8-inch...................do....	600	1.00	600.00	1.3500	810.00

Bids opened June 28, 1906, for Cold Springs dam, Umatilla project—Continued.

Work and material.	Quantity.	Sweeney & Holmes, Portland, Oreg.		Puget Sound Bridge and Dredging Co., Seattle, Wash.	
		Unit price.	Amount.	Unit price.	Amount.
Concrete:					
Class A.......................cubic yards..	1,250	$10.00	$12,500.00	$5.5000	$6,875.00
Class B.............................do....	500	11.00	5,500.00	6.5000	3,250.00
Class C.............................do....	800	12.00	9,600.00	10.5000	8,400.00
Class D.............................do....	560	14.00	7,840.00	5.7000	3,192.00
Total, alternative A..............	....	....	383,415.00	....	452,584.05
Total, alternative B..............	....	....	390,165.00	....	467.434.05

CEMENT.

Proposals for 8,000 barrels of cement, 6,000 barrels of which are to be used on the Umatilla project, were opened on May 17, and contract was awarded to the Pacific Portland Cement Company, of San Francisco. The following is a tabulation ot bids received:

Bids opened May 17, 1906, for cement for Umatilla project.

Bidder.	Delivery of cement.	Price bid per barrel.	Government freight rate from point of delivery to—		Net cost.	
			Brewster, Wash.	Hermiston, Oreg.	Brewster, Wash.	Hermiston, Oreg.
Pacific Portland Cement Co., San Francisco, Cal.	Tolenas, Cal......	$1.65	$1.86	$0.51	$3.51	$2.17
Alpena Portland Cement Co., Alpena, Mich.	Duluth, Minn.....	1.70	2.38	1.24	4.08	2.94
Illinois Steel Co., Chicago, Ill.....	Chicago..........	1.70	2.59	1.45	4.29	3.15
Balfour Guthrie Co., Portland, Oreg.	Portland, Oreg...	2.975	1.82	.48	4.795	3.455
Kansas Portland Cement Co., Iola, Kans.	Iola or Gas, Kans.	1.98	2.66	1.52	4.64	3.50
Portland Cement Co., Denver, Colo.	Portland, Oreg...	3.53	1.82	.48	5.35	4.01

STEEL.

Contract for about 40,500 pounds of steel for concrete reenforcement was awarded to Inland Steel Company on the basis of proposals received on June 15. Two bids were received as follows:

Expanded Metal and Corrugated Bar Company, of St. Louis, Mo., f. o. b. cars at Pueblo, Colo., $2 per hundredweight for all sizes.

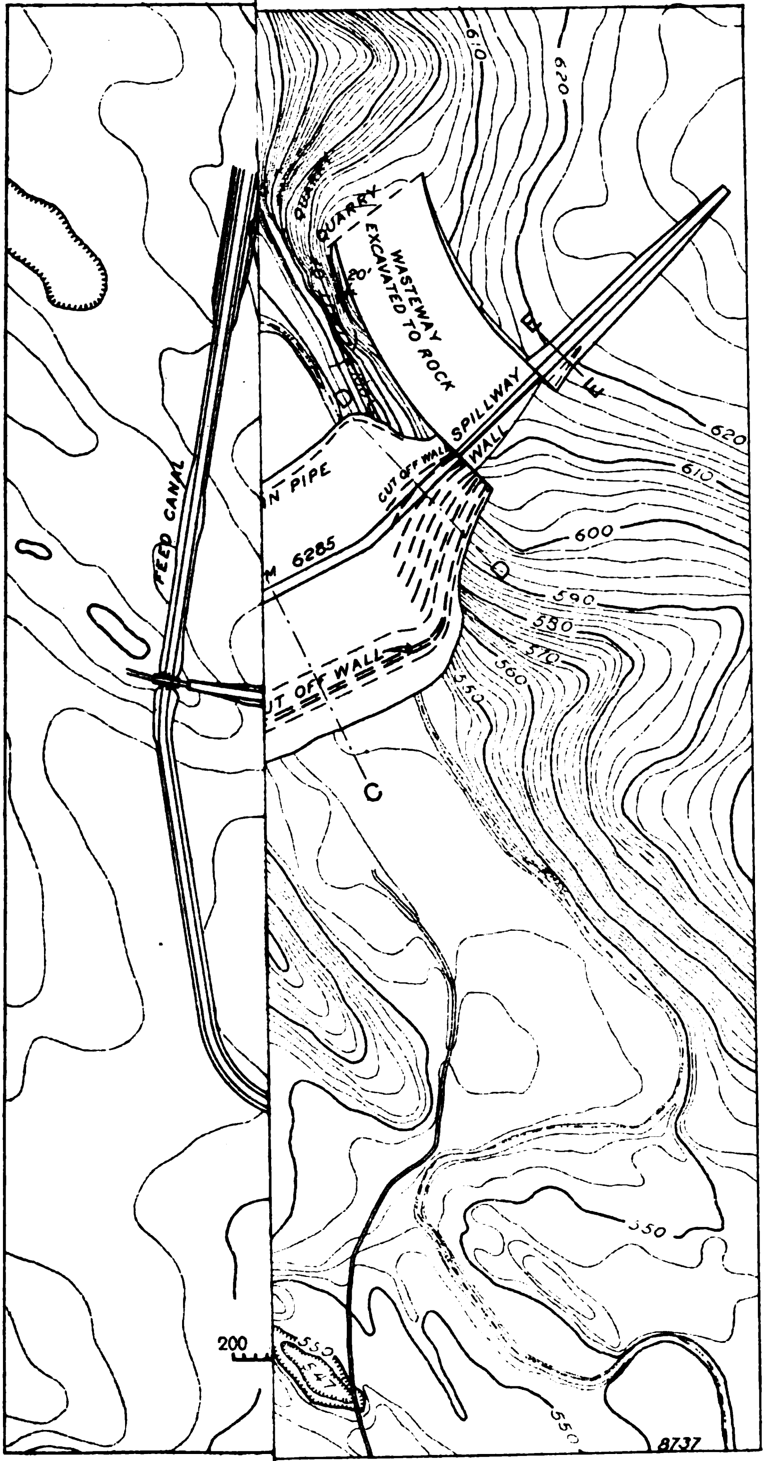
Inland Steel Company, of Chicago, Ill., f.o.b. Chicago, $1.65 to $1.85 per hundredweight for sizes required.

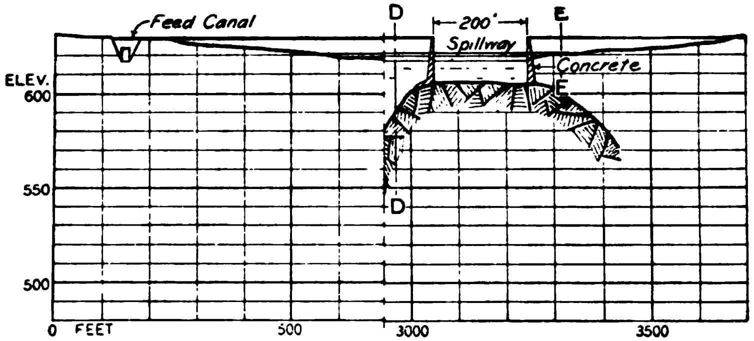
IRRIGABLE LANDS.

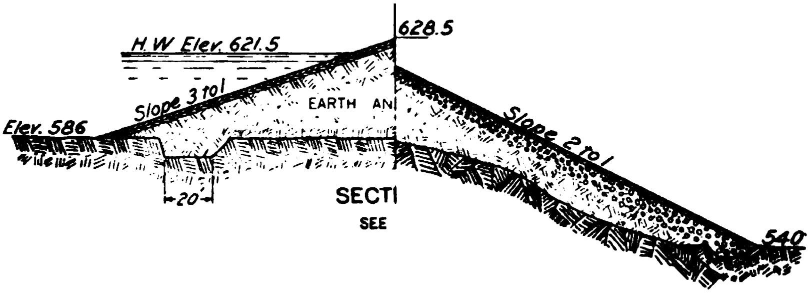
The area planned to be irrigated is 20,000 acres. The lands are rolling and considered very fertile. There is no alkali apparent on the surface, and wells show underground water remarkably free from it for an arid region.

A large portion of the irrigable land was found to be controlled by the Maxwell Land and Irrigation Company, which has constructed irrigation works that were dependent on the flood flow of the Umatilla River, but were incapable of furnishing water to the lands during

U. S. RECLAMATION S FIFTH ANNUAL REPORT PL. LXXVII







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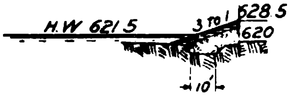

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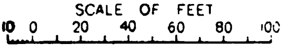

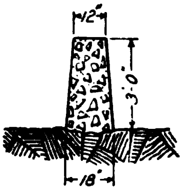

DETAIL OF CUTOFF WALLS

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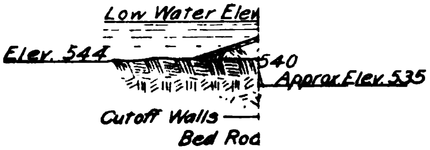

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LONGI OREGON.

midsummer. Negotiations were commenced with this company with a view to obtaining the subscription of the lands controlled by it to the project and the acquisition of its system by the United States. In consideration of $15,000 and a paid-up Government water right for 300 acres this company has agreed to sell its canal system to the United States. The distribution of the lands is shown by the following table:

Lands included in Umatilla project.

	Acres.	Percentages.
GENERAL.		
Total	23,130	....
Private	18,380	79
Public	4,750	21
Irrigable	20,000	87
Nonirrigable	3,130	14
PRIVATE.		
Total	18,380	....
Irrigable	15,890	86
Nonirrigable	2,490	14
Maxwell Land and Irrigation Co	6,040	33
Northern Pacific Railroad	1,260	7
Other land	11,080	60
PUBLIC.		
Total	4,750	....
Irrigable	4,110	87
PUBLIC—continued.		
Nonirrigable	640	13
IRRIGABLE.		
Total	20,000	....
Public	4,110	21
Private	15,890	79
Northern Pacific Railroad	910	6
Maxwell Land and Irrigation Co	5,190	33
Subscribed	14,590	92
Unsubscribed	1,300	8
Requiring pressure pipes	10,500	53
Not requiring pressure pipes	9,500	47
NONIRRIGABLE.		
Total	3,130	....
Public	640	20
Private	2,490	80

Generally throughout this project the soils have sufficient depth for profitable agriculture. The climatic conditions are also good, as there is a 200-day growing period between the first and last killing frosts, and a high degree of sunshiny days. The lands under this project are eminently suited to orchard and vine crops, and after several seasons it is probable that intensive farming will be practiced exclusively. When once established a 10-acre or 20-acre farm will adequately support a family, but the conditions during the initial years of improvement will require that the farmer should be able to raise the more common crops, such as grain and alfalfa.

In order that the conditions for the success of the settler may be as favorable as possible, it will probably be advisable to make the common unit 40 acres, while the lands advantageously located near the towns can be subdivided into 20-acre units.

RIGHT OF WAY.

Agreements for practically all right of way required over patented lands, except for one tract, have been obtained. The total amounts for which the United States is obligated in these agreements are as follows:

Reservoir site	$5,200
Feed canal	13,500
Purchase of Maxwell Land and Irrigation Company property and water rights	15,000
Total	33,700

WATER USERS' ASSOCIATION.

The Umatilla River Water Users' Association was organized in December, 1905, and through this organization about half the necessary area of land has been committed, the other half being either unpatented land or land covered by agreements with the Maxwell Land and Irrigation Company and the Northern Pacific Railway Company.

WEST DIVISION.

Investigations have shown that diversion from the John Day River to irrigate lands in the western division of the Umatilla project would require an expenditure of many million dollars before any lands could be watered. In view of the condition of the reclamation fund it was considered advisable to discontinue, for the present, studies for the irrigation of these lands from this source.

By reason of the high fertility, low altitude, and exceptional location of these lands surveys have been made to determine the feasibility of pumping a supply from Columbia River by means of water power developed on Deschutes River. The lower 30 miles of the Deschutes River Canyon has consequently been reconnoitered, and several sites for dams have been located. The average fall of Deschutes River ranges from 12 to 15 feet per mile, and the bottom lands and canyon sides are almost wholly unimproved. The sides are generally bold and rocky, and the power sites that have been located appear to offer favorable facilities for development up to 30,000 gross horsepower at each point. Arrangements have therefore been made for detailed surveys of practicable power sites. The length of power transmission line from Deschutes River to the Umatilla project will be between 60 and 70 miles, and the irrigable lands include about 58,000 acres that can be reached with a 300-foot lift, of which 33,000 acres can be reached with a 200-foot lift.

The economy of a pumping scheme of this nature largely depends upon the availability of storage reservoirs at or near the irrigated lands, so that pumping can be carried on continuously. There appears to be a reasonable prospect of finding some storage possibility of this character, and steps are now being taken to survey certain reservoir sites and to prepare estimates.

The public lands along Deschutes River from Sherar's bridge in T. 3 N., R. 14 E., W. M., to the mouth of the river have been withdrawn from entry. An application has been filed with the State engineer for the withdrawal of all unappropriated water rights in Deschutes River below the mouth of Warm Springs River for power development.

EXPENDITURES.

The expenditures on the Umatilla project are summarized in the following tables:

Expenditures according to physical features, on Umatilla project to June 30, 1906.

Features.	Engineering and administration.	Building.
Headquarters:		
Office		$275.00
Lodging and boarding houses		350.00
Warehouses and corrals		124.88
Irrigation structures:		
Diversion weir and embankment	$376.84	
Diversion headworks, gates, and land sluiceway	376.85	
Feed canal	376.85	500.00
Cold springs reservoir submerged lands	282.64	
Cold springs dam	282.64	414.84
Outlet canal, headworks and gates	282.63	
Outlet canal	282.63	
Distributing system	251.24	
Irrigable lands:		
Farm unit subdivision and soil examination	147.27	
Water Users' Association		
Examination of project as a whole, of which $22,757 is charged to West Branch (John Day) project	40,073.06	
Administration of project as a whole	10,444.12	
Total	53,176.77	1,664.72
Grand total		54,841.49

Expenditures, according to purpose and nature, on Umatilla project to June 30, 1906.

[Total, $54,841.49.]

	Services.	Traveling.	Subsistence.	Equipment.	Materials.	Supplies.	Rent and storage.	Forage.
Engineering:								
Examination	$5,547.50	$903.42	$842.33	$274.30	$3.69	$314.99	$2.74	$392.67
Survey	20,635.93	1,128.91	4,819.74	1,738.96	31.80	2,106.10	32.19	1,297.79
Design	2,312.03	15.20	65.20	28.43		91.46		
Subdivision	32.88	48.85		42.11		23.43		
Building:								
Rights and property	563.16	272.88	73.70			5.10		
Building	95.00				311.00	343.88		
Administration	7,537.16	1,249.23	29.49	539.20		776.10	312.56	.38

PROPOSED MALHEUR PROJECT.

Final estimates prepared by a board of engineers placed the acre cost of this project at $42, including ten years' maintenance, which is materially higher than had been estimated before, due to additional knowledge gained by more complete surveys and extensive drilling operations at dam site. Serious obstacles were encountered through unwillingness of private landowners to pledge their lands under conditions satisfactory to the Department, and through right of way and water right complications, and doubt was expressed by the settlers as to the value of the lands compared with estimated water charges.

Extensive studies were made of the possibility of reducing the area to be watered from Malheur River and utilizing Owyhee River for the irrigation of the remainder immediately south of Arcadia and additional land south of Owyhee River, thus dividing the project into a Malheur and Owyhee division.

It was found that such reduction would not materially alter the acre cost of the Malheur division, and it was hoped that as the Owyhee division promised to be more free from legal and land complications an attractive first unit could be worked out with Owyhee River as a source of supply. The summer flow of Owyhee River having been fully appropriated, examination was made of the Owyhee watershed for practicable storage reservoirs. At Duncans Ferry a favorable site was found for the construction of a dam, which if 100 feet high, would store 190,000 acre-feet, and if 150 feet high would store 480,000 acre-feet. A less favorable storage reservoir was located at Red Butte Valley. Diamond drill borings were made at both locations to determine position of bed rock at dam sites.

Preliminary plans and estimates were made on the basis of irrigating 63,000 acres—27,000 acres north of the Owyhee as far as Arcadia and 36,000 acres south of the river, principally south of Sucker Creek, and consequently in the State of Idaho.

Storage of 150,000 acre-feet with a 90-foot dam at Duncans Ferry was deemed sufficient in connection with available river flow during a portion of the irrigation season and was made the basis of estimates. A suitable point of diversion was located 4½ miles upstream from Mitchell Butte. The final results indicated an acre cost even higher than that of the Malheur division, for which reason work on the entire project has been indefinitely deferred. All lands withdrawn, except for reservoir sites, have been restored to entry.

The expenditures are summarized in the following table:

Expenditures, according to purpose and nature, on proposed Malheur project to June 30, 1906.

[Total, $71,067.22.]

	Services.	Traveling.	Subsistence.	Equipment.	Materials.	Supplies.	Rent and storage.	Forage.
Engineering:								
Examination	$3,201.22	$1,359.73	$409.61	$218.62		$263.70	$19.00	$204.
Survey	33,344.96	2,623.16	7,500.11	2,409.47	$11.38	2,785.46	37.60	2,363.
Design	426.21	79.75						
Subdivision	164.36	21.00		98.00				
Rights and property	760.28	226.70	85.50					
Administration	9,079.50	2,086.35	45.81	553.17		374.49	313.80	.53

PROPOSED CENTRAL OREGON PROJECTS.

Silver Creek, Chewaucan, Ana River, Silver Lake, Odell Lake, and Crescent Lake projects in central Oregon have been described in the Third Annual Report, second edition, pages 471 to 486. No further detailed investigations have been made in this region but stream measurement work has been continued in order to obtain information in regard to the available water supply in case it should be advisable to take up these projects in the future. The expenditures are summarized in the following table:

Expenditures, according to purpose and nature, on proposed central Oregon projects to June 30, 1906.

[Total, $22,629.23.]

	Services.	Traveling.	Subsistence.	Equipment.	Materials.	Supplies.	Rent and storage.	Forage.
Engineering:								
Examination	$2,474.71	$1,180.68	$409.66	$191.62		$300.05	$28.75	$420.
Survey	6,530.95	1,009.20	2,547.13	664.98	$2.00	1,267.31	32.50	630.
Design	403.59							
Administration	3,021.37	891.14	39.63	334.95		120.39	137.85	.6

OREGON-CALIFORNIA.

KLAMATH PROJECT.

GENERAL STATEMENT.

The principal data relating to the Klamath project are summarized below.

Summary of principal data relating to Klamath project.

Counties: Klameth, Oreg.; Siskiyou and Modoc, Cal.
Latitude: 42°.
Longitude: 121°.
Townships: 33–41 south, 6–14 east, W. M., 46–48 north, 1–8 east M. D. M.
Irrigable area: 236,000 acres.
Average rainfall: 15 inches.
Estimated run-off: 3,000 second-feet.
Range of temperature: Maximum, 105°; minimum, –26°.
Average elevation: 4,100 feet.
Principal products: Alfalfa, wheat, vegetables, and fruits.
Nearest railroad: Klamath Lake Railroad.
Nearest station: Pokegama, 36 miles.
Principal markets: San Francisco, Cal., 451 miles; Portland, Oreg., 443 miles.
Kind of headworks: Concrete.
Reservoir area: Clear Lake, 25,193 acres; Horsefly reservoir, 4,534 acres.
Capacity of reservoirs: Clear Lake, 462,356 acre-feet; Horsefly reservoir, 157,865 acre-feet.
Duty of water: 1 second-foot for 100 acres.
Height of dams: Clear Lake, 30; Horsefly, 70 feet.
Length of dams: Clear Lake, 850 feet; Horsefly, 480 feet.
Type of dams: Rock filled.
Length of canals: 174 miles.
Length of laterals: 255 miles.
Power developed: 2,000 horsepower.
Tunnels: 3,300 feet.
Per cent public land: 23.
Character of soil: Rich lake bottom, decomposed basalt.
Value of irrigated land: $20 to $100.
Beginning of survey: June, 1904.

The Klamath project (Pl. LXXIX) is situated in Klamath County, Oreg., and Modoc and Siskiyou counties, Cal. Within its area are Upper Klamath Lake in Oregon, Clear Lake in California, and Tule and Lower Klamath Lakes in California and Oregon (Pls. LXXX and LXXXI).

The two principal valleys included in the project are those of Lost River and the upper portion of Klamath River. Lost River drains the watershed tributary to Clear Lake, the latter acting as a natural reservoir for the partial control of the flow of that stream. Klamath River takes its water supply from Upper Klamath Lake, and its flow is also regulated by the natural storage afforded by this lake. Lost River from its source at Clear Lake in California makes a broad detour through Oregon and finally discharges its waters into Tule Lake near the Oregon-California boundary. The waters which reach this point are lost by evaporation from the surface of Tule Lake. Klamath River flows in a general southwesterly course and discharges its waters into the Pacific Ocean.

The sources of water supply for the project are Clear Lake and Upper Klamath Lake, both of which are admirable natural reservoir sites. Horsefly Reservoir site on Miller Creek, a tributary of Lost River, has also been considered as an auxiliary supply in case it should be necessary. Clear Lake requires but a low dam on Lost River to give it the necessary capacity, while Upper Klamath Lake requires only the construction of regulating works.

For convenience, the project is considered in two parts—an upper and a lower division. The upper division includes the portion of the project that takes its water supply from Lost River, while the lower division obtains water from Upper Klamath Lake. The lands of the upper division include Langells, Yonna, and the upper portion of Poe valleys. The lower division includes the Klamath Valley and the lower portion of Poe Valley, lands now in part under cultivation, and a portion of Tule and Lower Klamath lakes, which it is proposed to reclaim. The reclamation of Tule Lake will be accomplished by storing a part of the run-off into the lake for irrigation on the upper division and by diverting a part to Klamath River, thus allowing the lake area to shrink by evaporation. The reclamation of portions of Lower Klamath Lake and the adjacent marsh lands will be accomplished by drainage.

The work so far undertaken is all within the lower division, the lands to be watered by the first unit being in the upper portion of Klamath Valley and in the lower portion of Poe Valley.

In the following table are listed the contracts entered into for work on the Klamath project. This list includes contracts for excavation, embankment, masonry, and erection of structures, but does not include materials, such as cement, steel, timbers, etc.

Contracts for building work on Klamath project to June 30, 1906.

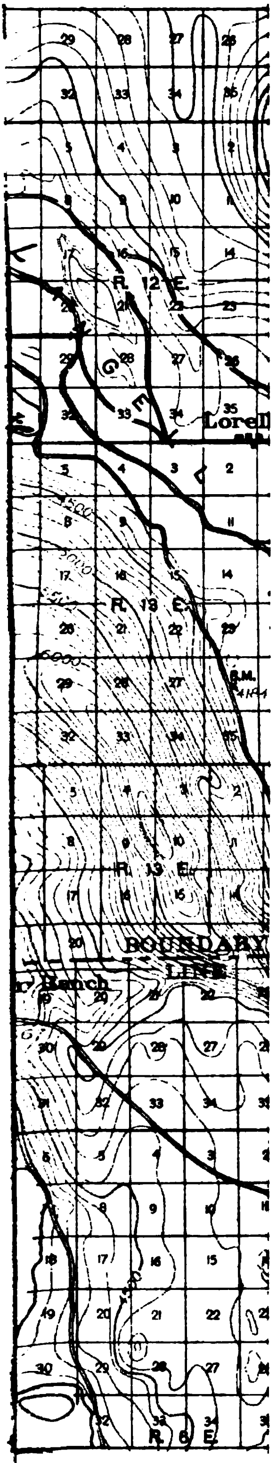
No. of contract.	Contractor.	Feature.	Estimated total value.	Payments to June 30, 1906.	Per cent paid.
87	Mason, Davis & Co	Main canal, divisions 1, 2, 3.	$377,330	$38,865.77	10
91	International Contract Co.	Highway bridges	6,828	....	....

MAIN CANAL.

Bids for divisions 1, 2, and 3 of the main canal were opened December 29, 1905. This work involves the excavation of the main canal (Pls. LXXXII–LXXXVI) and the building of the headworks, turnouts, and bridges from the intake at the head of Link River to the first main division point near Olene, a distance of about 9 miles. Of this distance 3,300 feet is tunnel and 2,700 feet cement-lined canal. The remainder is open cut in earth. The canal is designed to have a maximum capacity of 1,500 second-feet.

The contract for the first three schedules, which include all except the highway bridges, was awarded to Mason, Davis & Co., of Portland, Oreg. The contract for the 6 highway bridges was awraded to the International Contract Company, of Seattle, Wash.

Work was begun by the contractors during the latter part of March, 1906. Progress at first was much delayed by bad weather and by inability to obtain supplies and equipment by reason of the bad condition of the roads from the railway terminus to Klamath Falls.



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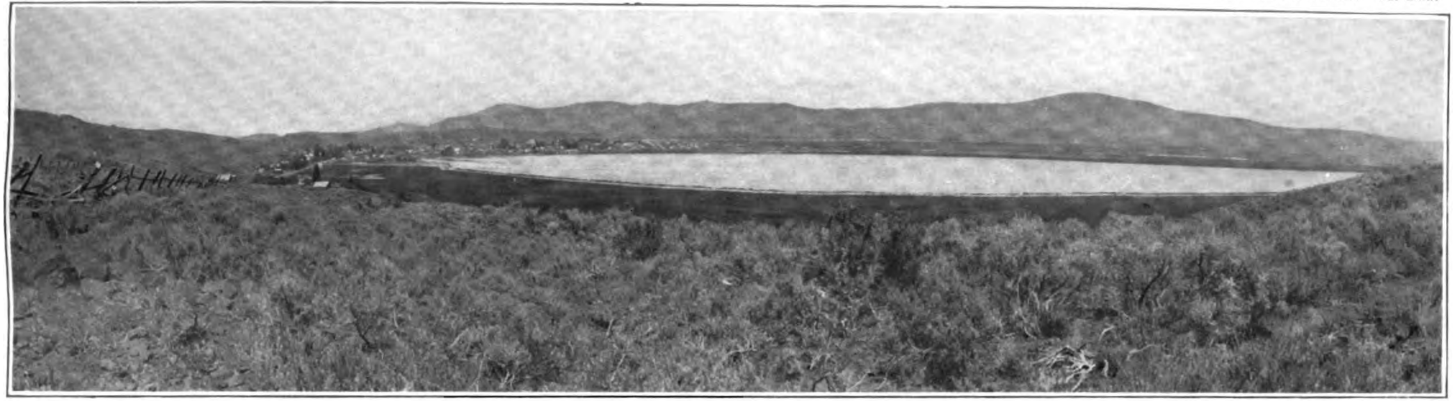
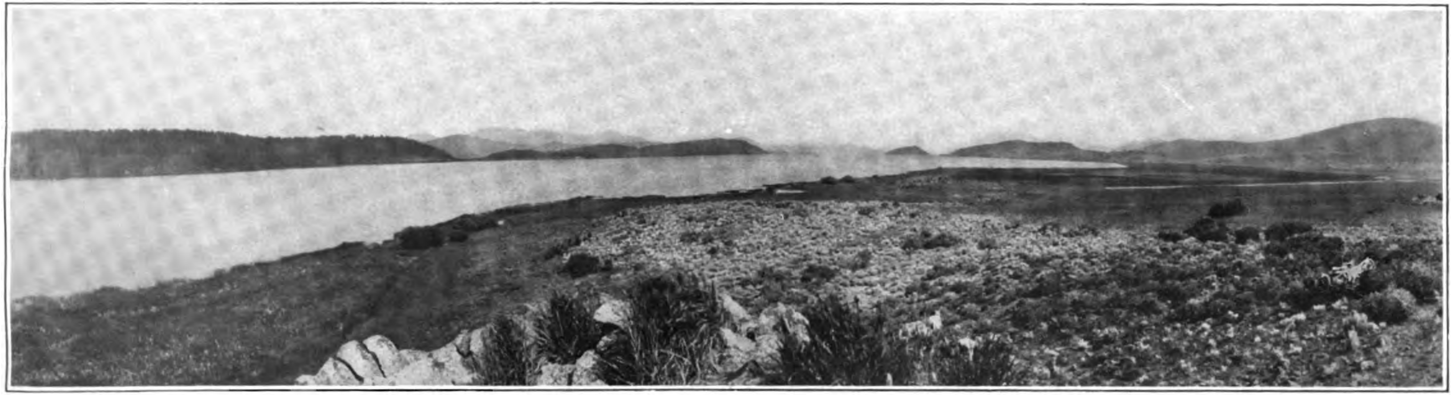
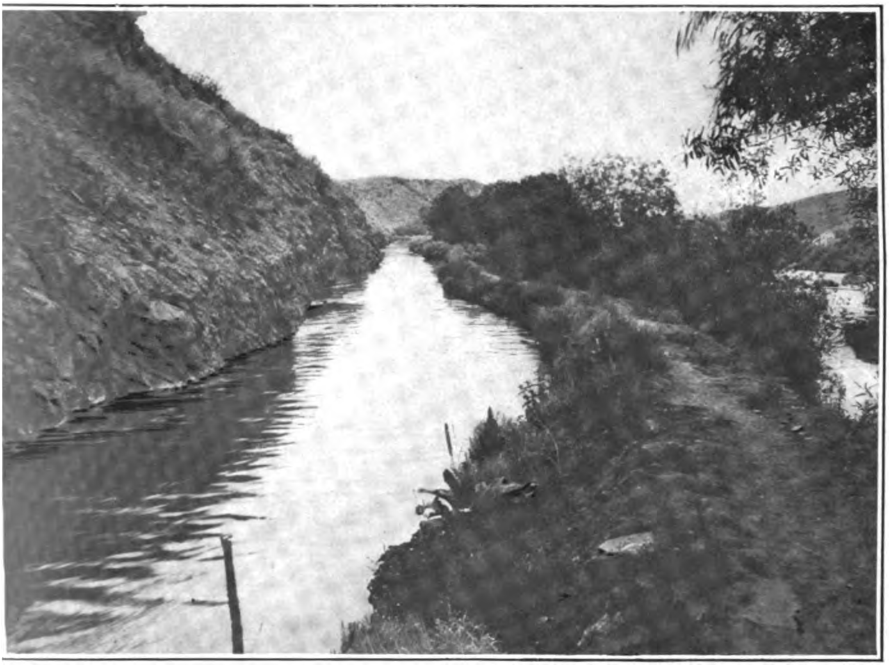


A. LAKE EWAUNA, OREGON, KLAMATH PROJECT, OREGON-CALIFORNIA.

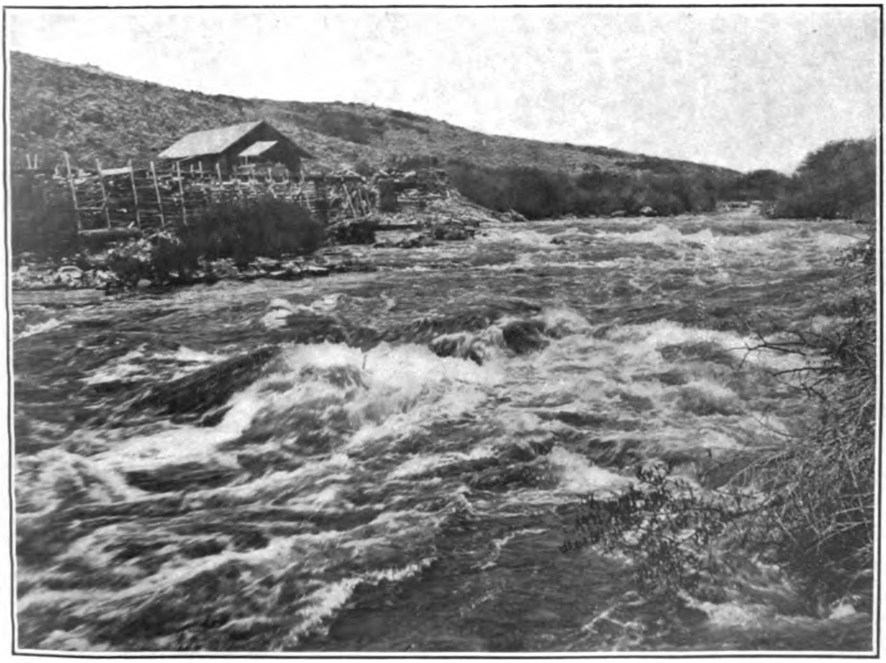
Showing the town of Klamath Falls situated at upper end of the lake.



B. LOOKING NORTHWEST FROM THE LOWER END OF UPPER KLAMATH LAKE, KLAMATH PROJECT, OREGON-CALIFORNIA.



A. ANKENY CANAL, KLAMATH PROJECT, OREGON-CALIFORNIA, FROM A POINT JUST BELOW THE HEADING.



B. KLAMATH FALLS, LINK RIVER, KLAMATH PROJECT, OREGON-CALIFORNIA.

Link River connects Upper Klamath Lake with Lake Ewauna, and on it is located the town of Klamath Falls.

The contract provides that work on this unit of the canal shall be finished in February, 1907, and it is expected that water will be delivered to the lands during the irrigating season of that year. The land irrigable from this first unit of the main canal is between 11,000 and 12,000 acres. This land lies on the east side of Klamath River, adjacent to the town of Klamath Falls, and is in the extreme upper portion of the Klamath Valley. All of it is held in private ownership.

Bid opened December 29, 1905, for main canal, Klamath project.

[Specifications No. 66.]

DIVISION 1.

Kind of work.	Quantity.	Mason, Davis & Co., Portland, Oreg.		Root & Fennick, San Francisco, Cal.[a]		Robert Wakefield, Portland, Oreg.	
		Unit price.	Amount.	Unit price.	Amount.	Unit price.	Amount.
Wet earth excavation:							
Class 1.......cubic yards..	6,700	$1.00	$6,700.00	$1.00	$6,700.00	$0.75	$5,025.00
Class 3..............do....	100	1.50	150.00	2.50	250.00	5.00	500.00
Dry earth excavation:							
Class 1..............do....	36,700	.18	6,606.00	.25	9,175.00	.20	7,340.00
Class 2..............do....	35,600	.35	12,460.00	.60	21,360.00	.93	33,108.00
Class 3..............do....	35,700	1.25	44,625.00	1.10	39,270.00	2.00	71,400.00
Paving.........square yards..	6,900	.75	5,175.00	1.00	6,900.00	2.50	17,250.00
Headworks—steel gates and guides, standard screws, and all operating mechanism complete in place............	6	750.00	4,500.00	1,000.00	6,000.00	960.00	5,760.00
Concrete in canal lining, bridge piers, turn-outs, culverts, headworks, and tunnel portals............cubic yards..	4,000	8.00	32,000.00	9.00	36,000.00	9.00	36,000.00
Reenforced concrete in headworks ....cubic yards..	10	15.00	150.00	10.00	100.00	20.00	200.00
Tunnel:							
Excavation ...linear feet ..	3,100	25.00	77,500.00	42.00	130,200.00	28.50	88,350.00
Concrete lining......do....	3,100	16.00	49,600.00	18.00	55,800.00	24.00	74,400.00
Puddling.........cubic yards..	100	1.00	100.00	1.00	100.00	3.00	300.00
Total................			239,566.00		311,855.00		339,633.00

Kind of work.	Quantity.	Curtis Engineering Co., New York, N. Y.		Stone & Stone, Oakland, Cal.[d]		San Francisco Bridge Co., San Francisco, Cal.	
		Unit price.	Amount.	Unit price.	Amount.	Unit price.	Amount.
Wet earth excavation:							
Class 1.......cubic yards..	6,700	$1.00	$6,700.00	$2.50	$16,750.00	$1.00	$6,700.00
Class 3..............do....	100	10.00	1,000.00	5.00	500.00	2.00	200.00
Dry earth excavation:							
Class 1..............do....	36,700	.25	9,175.00	.50	18,350.00	.28	10,276.00
Class 2..............do....	35,600	.45	16,020.00	.75	26,700.00	.55	19,580.00
Class 3..............do....	35,700	1.50	53,550.00	1.25	44,625.00	1.00	35,700.00
Paving..........square yards..	6,900	1.50	10,350.00	2.50	17,250.00	2.00	13,800.00
Headworks—steel gates and guides, standard screws, and all operating mechanism complete in place............	6	1,200.00	7,200.00	1,500.00	9,000.00	900.00	5,400.00
Concrete in canal lining, bridge piers, turn-outs, culverts, headworks, and tunnel portals............cubic yards..	4,000	7.50	30,000.00	12.00	48,000.00	11.10	44,400.00
Reenforced concrete in headworks.........cubic yards..	10	15.00	150.00	14.00	140.00	20.00	200.00
Tunnel;							
Excavation....linear feet..	3,100	47.00	145,700.00	35.00	108,500.00	32.50	100,750.00
Concrete lining......do....	3,100	17.00	52,700.00	15.00	46,500.00	17.00	52,700.00
Puddling.........cubic yards..	100	1.00	100.00	1.50	150.00	1.50	150.00
Total................			332,645.00		336,465.00		289,856.00

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[a] All work or none.

Bid opened December 29, 1905, for main canal, Klamath project—Continued.

DIVISION 1—Continued.

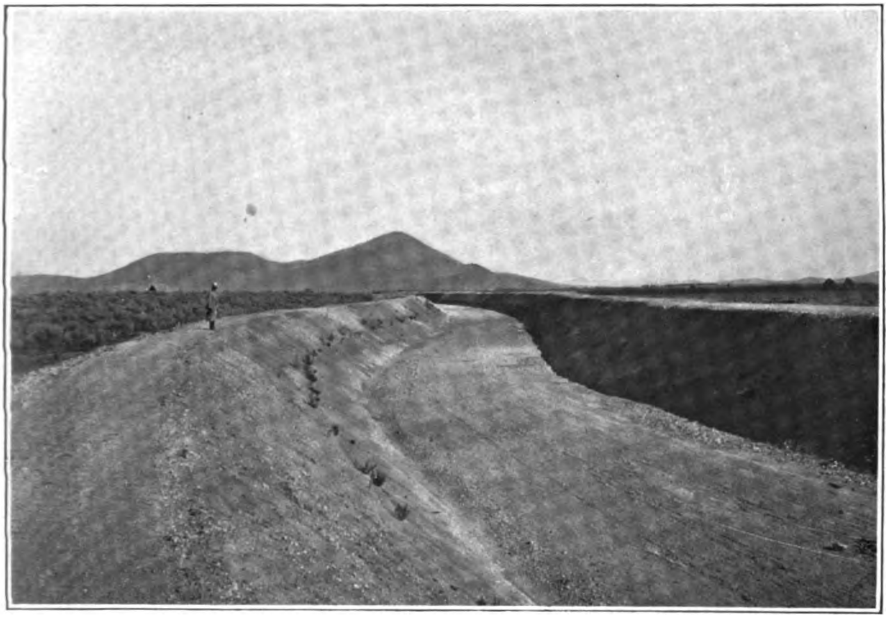
Kind of work.	Quantity.	William K. Brown, Hollister, Cal.		Bay and River Dredging Co., San Francisco, Cal.		Cotton Bros. Co., Oakland, Cal.	
		Unit price.	Amount.	Unit price.	Amount.	Unit price.	Amount.
Wet earth excavation:							
Class 1.......cubic yards..	6,700	$2.000	$13,400.00	$0.56	$3,752.00	$0.30	$2,010.00
Class 3..............do....	100	5.000	500.00	6.75	675.00	3.00	300.00
Dry earth excavation:							
Class 1..............do....	36,700	.600	22,020.00	.40	14,680.00	.18	6,606.00
Class 2..............do....	35,600	.700	24,920.00	.56	19,936.00	1.22	43,432.00
Class 3..............do....	35,700	.800	28,560.00	.68	24,276.00	1.22	43,554.00
Paving.........square yards..	6,900	2.250	15,525.00	3.00	20,700.00	.48	3,312.00
Headworks—steel gates and guides, standard screws, and all operating mechanism complete in place............	6	1,333.333	8,000.00	995.00	5,970.00	920.00	5,520.00
Concrete in canal lining, bridge piers, turn-outs, culverts, headworks, and tunnel portals............cubic yards..	4,000	15.000	60,000.00	16.25	65,000.00	9.00	36,000.00
Reenforced concrete in headworks ....cubic yards..	10	15.000	150.00	20.00	200.00	10.00	100.00
Tunnel:							
Excavation....linear feet..	3,100	75.000	232,500.00	45.00	139,500.00	48.75	151,125.00
Concrete lining......do....	3,100	29.000	89,900.00	30.25	93,775.00	15.50	48,050.00
Puddling.........cubic yards .	100	2.500	250.00	2.00	200.00	1.00	100.00
Total....................			495,725.00	....	388,664.00	....	340.109.00

DIVISION 2.

Kind of work.	Quantity.	Mason, Davis & Co., Portland, Oreg.		Root & Fennick, San Francisco, Cal.[a]	
		Unit price.	Amount.	Unit price.	Amount.
Dry earth excavation:					
Class 1........................cubic yards..	237,800	$0.18	$42,804.00	$0.25	$59,450.00
Class 2..............................do....	65,600	.35	22,960.00	.60	39,360.00
Class 3..............................do....	100	1.25	125.00	1.10	110.00
Concrete in bridge piers, turn-outs, and culverts, cubic yards....................................	400	7.00	2,800.00	9.00	3,600.00
Reenforced concrete in culverts ...cubic yards..	150	12.00	1,800.00	10.00	1,500.00
Paving...........................square yards..	500	1.00	500.00	1.50	750.00
Puddling........................cubic yards..	100	1.00	100.00	1.00	100.00
Total....................................		....	71,089.00	....	104,870.00

Kind of work.	Quantity.	Robert Wakefield, Portland, Oreg.		Curtis Engineering Co., New York, N. Y.	
		Unit price.	Amount.	Unit price.	Amount.
Dry earth excavation:					
Class 1........................cubic yards..	237,800	$0.24	$57,072.00	$0.22	$52,316.00
Class 2..............................do....	65,600	.53	34,768.00	.45	29,520.00
Class 3..............................do....	100	2.00	200.00	3.00	300.00
Concrete in bridge piers, turn-outs, and culverts.........................cubic yards..	400	15.00	6,000.00	7.50	3,000.00
Reenforced concrete in culverts..........do....	150	20.00	3,000.00	15.00	2,250.00
Paving.........................square yards..	500	2.50	1,250.00	2.50	1,250.00
Puddling........................cubic yards..	100	3.00	300.00	1.00	100.00
Total....................................		....	102,590.00	....	88,736.00

[a] All work or none.



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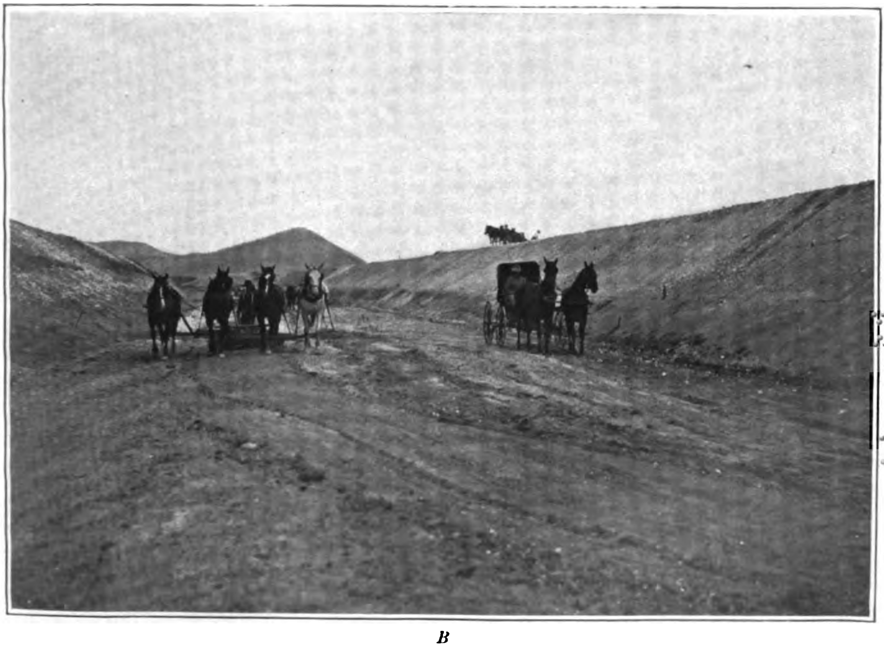
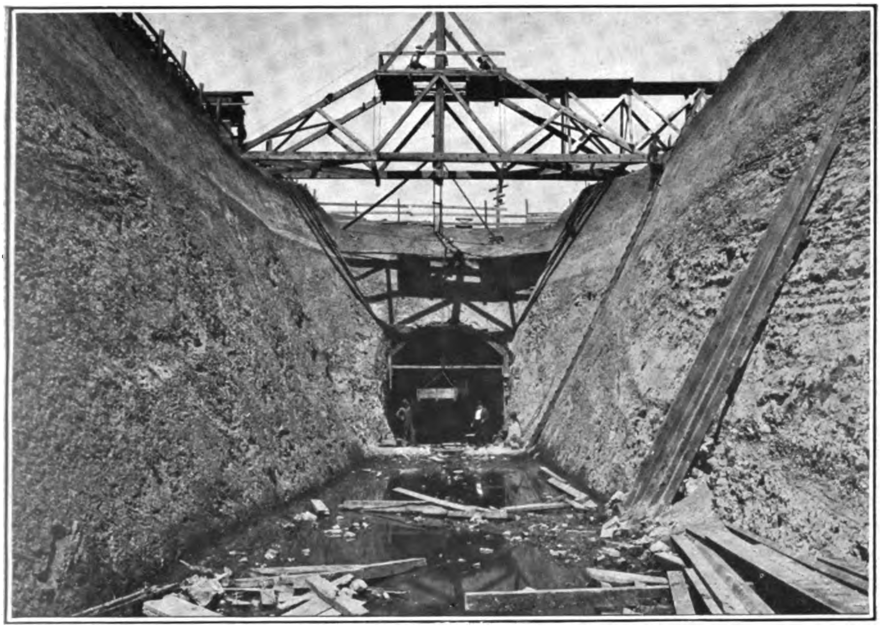
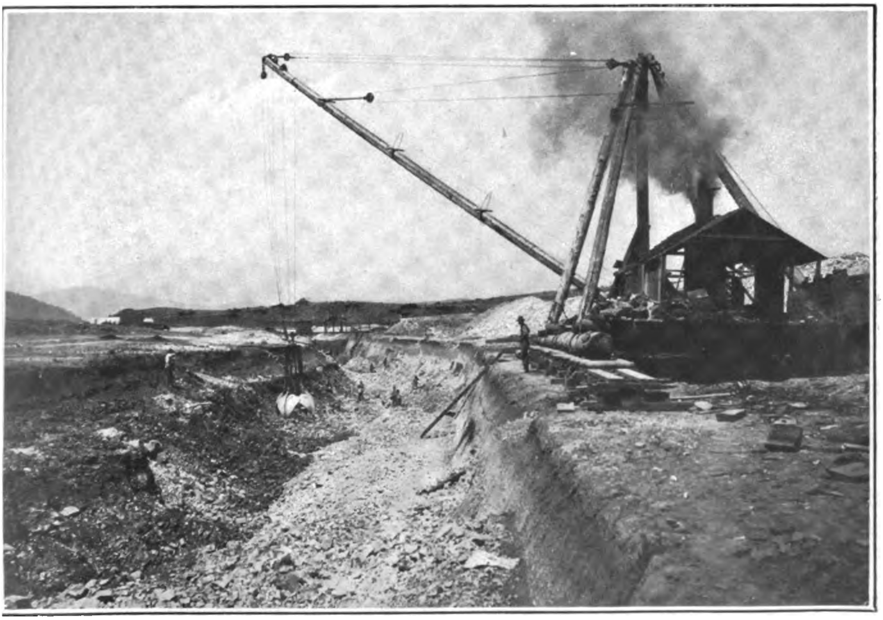


B

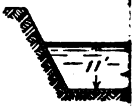
A AND *B*. MAIN CANAL, KLAMATH PROJECT, OREGON-CALIFORNIA.

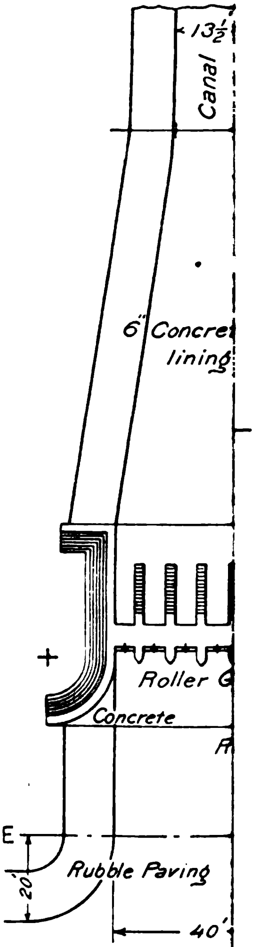


A. LOWER PORTAL OF TUNNEL ON MAIN CANAL, KLAMATH PROJECT, OREGON-CALIFORNIA.

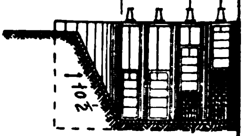


B. MAIN CANAL ABOVE TUNNEL, KLAMATH PROJECT, OREGON-CALIFORNIA.

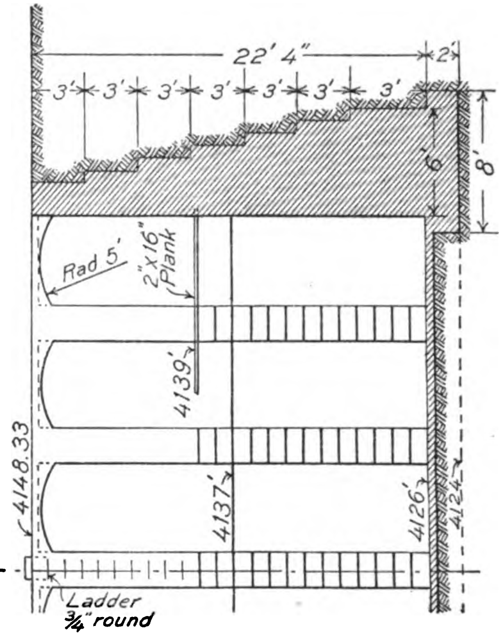




PLAN OF HEA

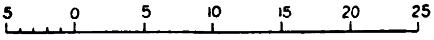


SECTIONAL ELEV



SECTIONAL ELEVATION A-B

SCALE OF FEET



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Bid opened December 29, 1905, for main canal, Klamath project—Continued.

DIVISION 2—Continued.

Kind of work.	Quantity.	Stone & Stone, Oakland, Cal.[a]		Beard & Beard, Modesto, Cal.		Clement & Strang, Salt Lake, Utah.	
		Unit price.	Amount.	Unit price.	Amount.	Unit price.	Amount.
Dry earth excavation:							
Class 1........cubic yards..	237,800	$0.19	$45,182.00	$0.24	$57,072.00	$0.159	$37,810.20
Class 2...............do....	65,600	.75	49,200.00	.44	28,864.00	.420	27,552.00
Class 3...............do....	100	1.25	125.00	.85	85.00	2.000	200.00
Concrete in bridge piers, turnouts, and culverts............cubic yards..	400	12.00	4,800.00	15.00	6,000.00	6.800	2,720.00
Reenforced concrete in culverts........cubic yards..	150	14.00	2,100.00	20.00	3,000.00	7.500	1,125.00
Paving..........square yards..	500	2.50	1,250.00	5.00	2,500.00	2.000	1,000.00
Puddling.........cubic yards..	100	1.50	150.00	.30	30.00	.750	75.00
Total....................	....	....	102,807.00	....	97,551.00	....	70,482.20

DIVISION 3.

Kind of work.	Quantity.	Mason, Davis & Co., Portland, Oreg.		Root & Fennick, San Francisco, Cal.[a]		Robert Wakefield, Portland, Oreg.	
		Unit price.	Amount.	Unit price.	Amount.	Unit price.	Amount.
Dry earth excavation:							
Class 1........cubic yards..	250,000	$0.18	$45,00.000	$0.25	$62,500.00	$0.19	$47,500.00
Class 2...............do....	50,000	.35	17,500.00	.60	30,000.00	.49	24,500.00
Class 3...............do....	100	1.25	125.00	1.10	110.00	2.50	250.00
Concrete in bridge piers, turnouts, and culverts ....cubic yards..	350	7.00	2,450.00	9.00	3,150.00	15.00	5,250.00
Reenforced concrete in culverts............cubic yards..	100	12.00	1,200.00	10.00	1,000.00	20.00	2,000.00
Paving..........square yards..	300	1.00	300.00	1.50	450.00	2.50	750.00
Puddling.........cubic yards..	100	1.00	100.00	1.00	100.00	3.00	300.00
Total....................	....	....	66,675.00	....	97,310.00	....	80,550.00

Kind of work.	Quantity.	Curtis Engineering Co., New York, N. Y.		Stone & Stone, Oakland, Cal.[a]		Beard & Beard, Modesto, Cal.	
		Unit price.	Amount.	Unit price.	Amount.	Unit price.	Amount.
Dry earth excavation:							
Class 1........cubic yards..	250,000	$0.22	$55,000.00?	$0.19	$47,500.00	$0.188	$47,000.00
Class 2...............do....	50,000	.45	22,500.00	.75	37,500.00	.350	17,500.00
Class 3...............do....	100	3.00	300.00	1.25	125.00	.600	60.00
Concrete in bridge piers, turnouts, and culverts ,..........cubic yards..	350	7.50	2,625.00	13.00	4,550.00	15.000	5,250.00
Reenforced concrete in culverts...........cubic yards..	100	15.00	1,500.00	15.00	1,500.00	18.000	1,800.00
Paving ....square yards..	300	2.50	750.00	2.75	825.00	4.500	1,350.00
Puddling. ....cubic yards..	100	1.00	100.00	1.50	150.00	.300	30.00
Total....................	....	....	82,775.00	....	92,150.00	....	72,990.00

[a] All work or none.

Bid opened December 29, 1905, for main canal, Klamath project—Continued.

DIVISION 3—Continued.

Kind of work.	Quantity.	Clement & Strang, Salt Lake, Utah.		Harry L. Millerd, Chicago, Ill.		R. A. Moncure, Reno, Nev.[a]	
		Unit price.	Amount.	Unit price.	Amount.	Unit price.	Amount.
Dry earth excavation:							
Class 1.......cubic yards.	250,000	$0.159	$39,750.00	$0.23	$57,500.00	$0.295	$51,250.00
Class 2..............do....	50,000	.420	21,000.00	.45	22,500.00	.400	20,000.00
Class 3..............do....	100	2.000	200.00	2.00	200.00	1.000	100.00
Concrete in bridge piers, turnouts, and culverts, cubic yards..	350	6.800	2,380.00	8.00	2,800.00	9.000	3,150.00
Reenforced concrete in culverts, cubic yards................	100	7.500	750.00	8.00	800.00	9.000	900.00
Paving.........square yards..	300	2.000	600.00	3.00	900.00	2.500	750.00
Puddling.........cubic yards..	100	.750	75.00	2.00	200.00	1.500	150.00
Total..................	....	....	64,755.00	....	84,900.00	....	76,300.00

BRIDGES, ALL DIVISIONS.

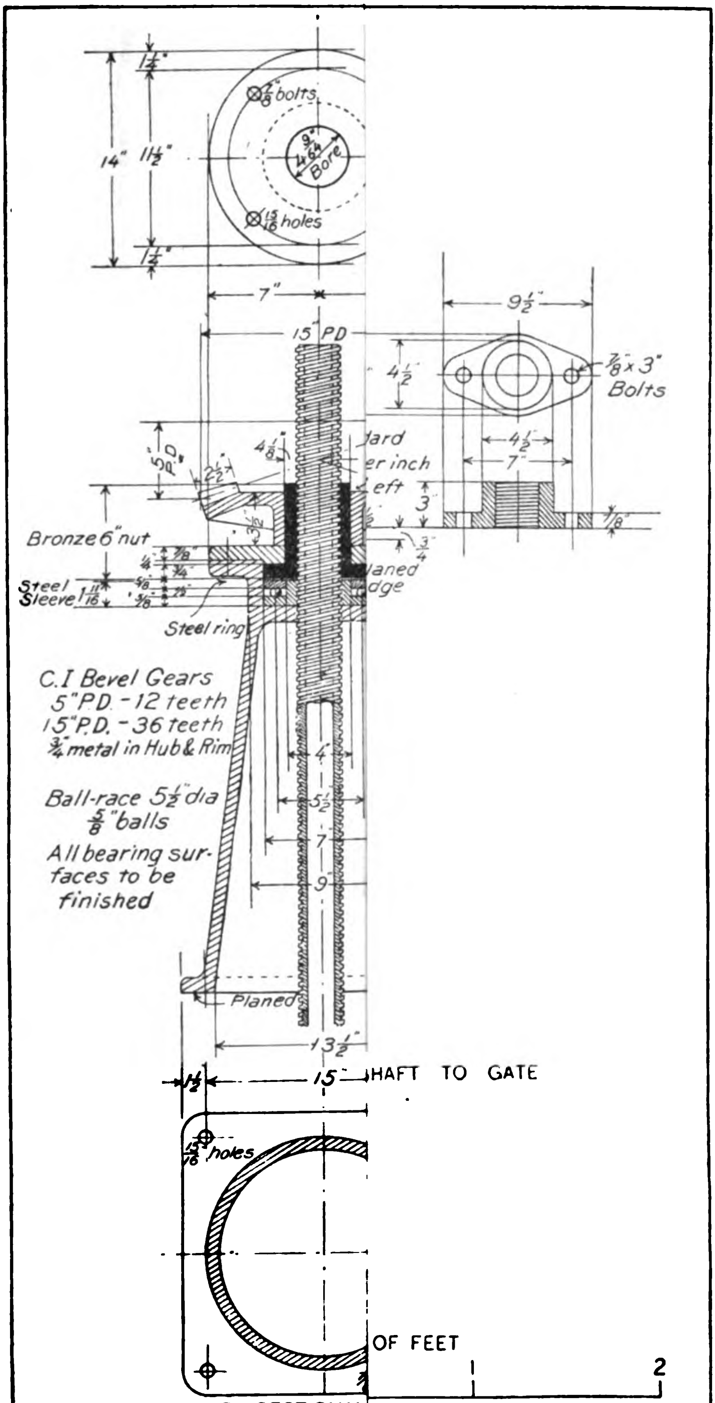
Kind of work.	Spans.	Mason, Davis & Co., Portland, Oreg.		Root & Fennick, San Francisco, Cal.[a]	
		Unit price.	Amount.	Unit price.	Amount.
Eighty-six-foot Howe truss span superstructure complete in place..........................	5	$1,720.00	$8,600.00	$1,500.00	$7,500.00
Eighty-foot Howe truss span superstructure complete in place..............................	1	1,600.00	1,600.00	1,490.00	1,490.00
Total.........		....	10,200.00	....	8,990.00

Kind of work.	Spans.	Robert Wakefield, Portland, Oreg.		Curtis Engineering Co., New York, N. Y.	
		Unit price.	Amount.	Unit price.	Amount.
Eighty-six-foot Howe truss span superstructure complete in place..........................	5	$3,100.00	$15,500.00	$1,320.00	$6,600.00
Eighty-foot Howe truss span superstructure complete in place..............................	1	2,900.00	2,900.00	1,250.00	1,250.00
Total..		....	18,400.00	....	7,850.00

Kind of work.	Spans.	Stone & Stone, Oakland, Cal.[a]		San Francisco Bridge Co., San Francisco, Cal.	
		Unit price.	Amount.	Unit price.	Amount.
Eighty-six-foot Howe truss span superstructure complete in place..........................	5	$2,250.00	$11,250.00	$1,280.00	$6,400.00
Eighty-foot Howe truss span superstructure complete in place..............................	1	2,000.00	2,000.00	1,230.00	1,230.00
Total..		....	13,250.00	....	7,630.00

Kind of work.	Spans.	International Contract Co., Seattle, Wash.		Cotton Bros. Co., Oakland, Cal.	
		Unit price.	Amount.	Unit price.	Amount.
Eighty-six-foot Howe truss span superstructure complete in place..........................	5	$1,158.00	$5,790.00	$1,280.00	$6,400.00
Eighty-foot Howe truss span superstructure complete in place..............................	1	1,038.00	1,038.00	1,200.00	1,200.00
Total..		....	$6,828.00	....	7,600.00

[a] All work or none.

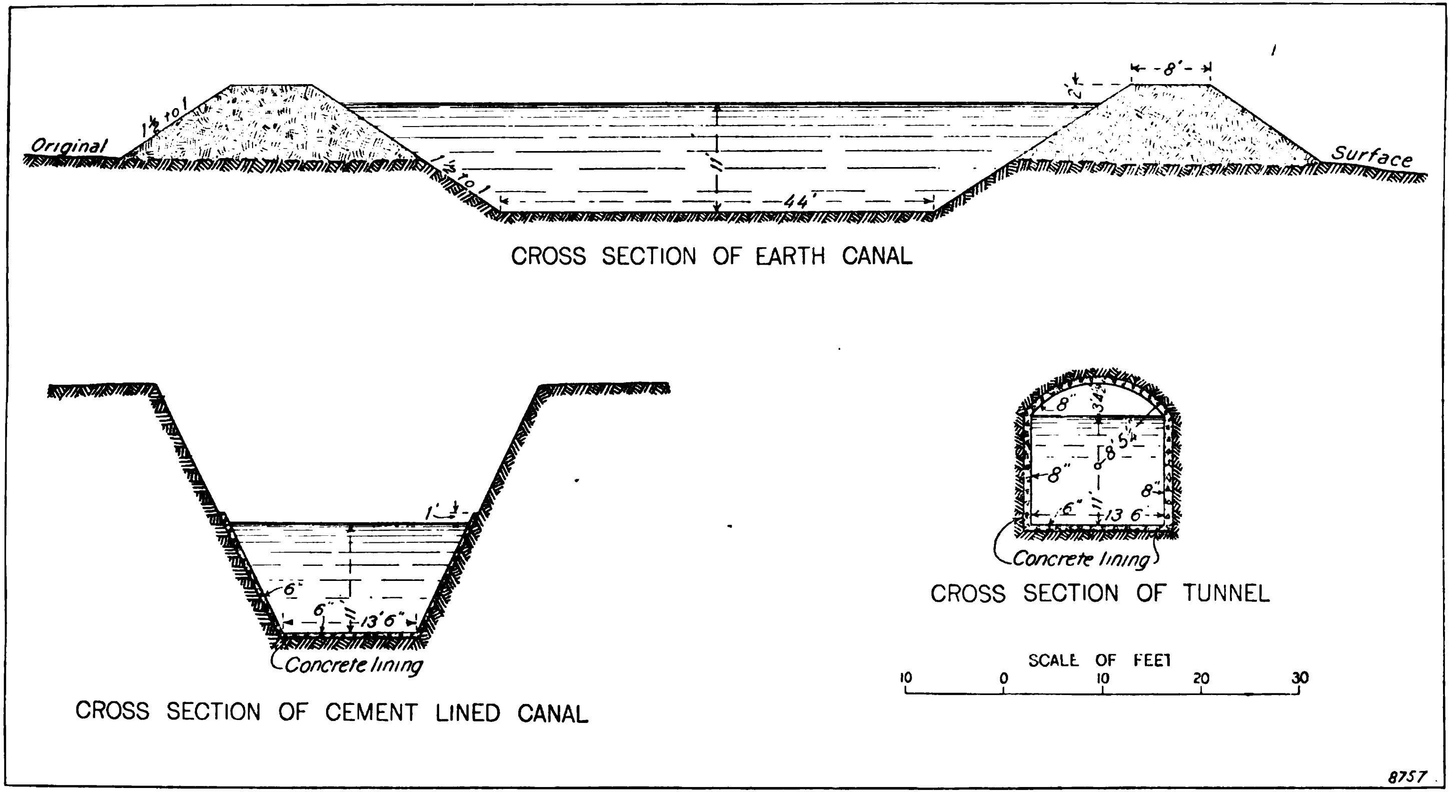


PLAN AND SECTIONAL

CAST IRON

8845

DETAILS OF BALL-BEARI OREGON-CALIFORNIA.



CROSS SECTIONS OF MAIN CANAL AND TUNNEL, KLAMATH PROJECT, OREGON-CALIFORNIA.

Cement for the main canal is furnished by the United States. Bids for from 8,000 to 10,000 barrels were opened March 16, 1906, and the contract was awarded to the Pacific Portland Cement Company of San Francisco for $1.55 per barrel on board the cars at Tolenas, Cal.

Bids opened March 16, 1906, for cement for Klamath project.

[Specifications No. 75.]

	Place of delivery.	Price per barrel.	Freight per barrel.	Total cost.
Pacific Portland Cement Co	F. o. b., Tolenas, Cal	$1.55	$0.32	$1.87
Western States Portland Cement Co	F. o. b., Independence, Kans	1.45	1.56	3.01

EAST BRANCH CANAL AND POE VALLEY LATERALS.

Early in 1906 bids were invited for excavating the East Branch Canal from the terminus of the first unit of the main canal to near Merrill, a distance of about 19 miles, and also for the north and south Poe Valley canals, which have a total length of about 27 miles. The East Branch Canal is designed for a maximum capacity of 261 second-feet at its head and will furnish water to the greater portion of Poe Valley, to the lands below Olene and east of Lost River, and to the lands on the northern and eastern sides of Tule Lake. It was expected that this work could be completed in time for the irrigating season of 1907, and the time limit for the contract was fixed for May 1, 1907. Bids were to have been opened June 21, 1906. No bids were received for the work, however. This was probably due to the general scarcity of labor prevailing on the Pacific coast, contractors not caring to assume the responsibility of completing the work within the specified time.

LATERALS UNDER MAIN CANAL.

The lateral system under the first unit of the main canal is being built by force account, as part of the land is already under irrigation from the canal of the Klamath Falls Irrigating Company, and it was believed the work could be accomplished with less interference with the work of the farmers if done by the Service than by contract. In accordance with these recommendations authority was asked and obtained to purchase the necessary equipment and construct the work. During May, 1906, 100 head of horses, together with the necessary tools and camp equipment, were purchased and camps established, and excavations begun in June.

GENERAL SURVEYS.

A portion of the lands situated near Merrill, Oreg., along the northwestern shore of Tule Lake are topographically of such a nature as to afford insufficient surface drainage. These lands, which have been irrigated for a number of years from the Little Klamath water ditch are beginning to show the effect of alkali. This condition is undoubtedly the result of evaporation of surplus irrigation waters. In order to obtain data necessary for designing an efficient system of drainage ditches for this section, a study of the ground water conditions was begun in the spring of 1906.

Diamond-drill borings to determine the character of rock at the Horsefly dam site were made during the latter part of 1905. Nine holes were put down to depths ranging from 8 to 89 feet. Hard lava rock was encountered at an average depth of about 15 feet. Below this depth the rock, although hard in places, is porous, and also contains soft seams, which are not water-tight. In one case small leakage was encountered at a depth of 50 feet.

In the immediate vicinity of Klamath Falls, there is no sand suitable for the concrete work for the main canal and tunnel lining. The nearest available points at which sand was found are on Upper Klamath Lake, the greater deposits being at the mouths of Williamson and Wood rivers. To obtain this sand it would be necessary to dredge it from the bottom of the lake and transport it by barges to the intake of the canal at the head of Link River. Investigation showed that in the region of Klamath Falls the only rock suitable for making artificial sand is the black basalt. Samples of sand made from this rock were tested by Mr. E. Duryee at Roosevelt and also in the Reclamation Service laboratory at Berkeley, and in both cases the results were satisfactory. In June, 1906, an order was placed with the Allis-Chalmers Company, of Chicago, Ill., for a complete sand-crushing plant to be used for manufacturing sand required in future force account and contract work on the project. The capacity of this plant is specified as 2 cubic yards of sand per hour.

In March and April, 1906, a survey was made of Klamath River below Keno, Oreg., in order to determine the amount of fall available for power purposes. The survey, which was made by means of transit and stadia, was carried from Keno down as far as Beswick, Cal., a distance of approximately 28 miles. The total drop in this distance is 1,426 feet, or an average of about 51 feet per mile. Over portions of the distance the drop is 100 feet per mile.

From Keno, Oreg., to within a few miles of Klamathon, Cal., all public lands adjacent to the river are withdrawn from entry under the first form.

PURCHASE OF LANDS AND RIGHTS OF WAY.

The purchase of the properties of the Klamath Canal Company has been consummated, the deed having been placed on record May 1, 1906. The title papers relating to the properties of the Klamath Falls Irrigating Company, known as the Ankeny canal, are pending before the Department. The papers relating to the purchase of the Adams canal, belonging to the Little Klamath Water Ditch Company, have been returned to the local office, and the company requested to perfect its title. An agreement with Moore Brothers for the purchase of their canal and water rights west of Link River has been executed and approved, substantially upon the terms stated in the last report.

An agreement was entered into July 1, 1905, with S. L. Akins and wife for the purchase of lands for reservoir site on and about Clear Lake, in Modoc County, Cal., and for canal rights of way, including the extension of the Adams canal, over certain lands on and about Tule Lake, in California and Oregon, together with certain riparian and accretion rights to the lake bed. The United States attorneys for Oregon and California are now considering the title.

On February 20, 1906, an agreement was made with Thomas McCormick for the purchase of water rights and rights of way for the proposed Keno cut for lowering the level of Klamath River. This agreement embraces also riparian rights pertaining to McCormick's lands in the vicinity. The abstract of title to these properties is now being perfected.

In addition to the foregoing more than one hundred agreements for the conveyance of lands for canal rights of way and other purposes have been obtained and are in various stages of preparation for consummation. The larger numbers have been approved and recorded and await definite location of canal lines before applying for deeds.

The legislatures of Oregon and California at their last sessions granted to the United States lands in the beds of Upper Klamath, Lower Klamath, and Tule lakes within their respective borders left uncovered by the operations of the Reclamation Service. Since the acts granting such lake-beds lands the State land board of Oregon has ceased to dispose of any lands, either as swamp or lake bed, within the limits of the lakes affected. In California no applications are entertained for the purchase of State lands left bare by the recession of the waters of lakes. Before the passage of the act granting said lake-bed lands to the United States applications for the purchase of all lands under Lower Klamath and Tule lakes within the State had been filed. But with few unimportant exceptions none of these applications were perfected, owing to the fact that the land was covered with water and the necessary surveys could not be made. These filings have now expired by limitation and are so designated on the records.

WATER USERS' ASSOCIATION.

The Klamath Water Users' Association, which was organized in March, 1905, has worked in harmony with the engineers of the Reclamation Service in matters pertaining to the signing up of land and the procuring of trust deeds for excess lands. The contract between the association and the Secretary of the Interior, by which the association assumes the responsibility for the payment to the United States of the cost of irrigation works, was ratified by the stockholders of the association November 3, 1905, and later signed by the Secretary of the Interior.

It is estimated that 110,000 acres of private lands under the gravity canals have been subscribed. Of this amount 40,000 acres are held in tracts in excess of 160 acres by individual owners. Of these excess lands 90 per cent are covered by trust deeds to the association.

IRRIGABLE LANDS.

The distribution of the lands under this project is shown in the following table:

Lands included in Klamath project.

GENERAL.

	Acres.	Percentages.		Acres.	Percentages.
Total	270,006	....	**IRRIGABLE.**		
Private	207,778	77	Total	191,801	....
Public	62,228	23	In Klamath County, Oreg.	136,402	71
Irrigable	191,801	71	In Modoc and Siskiyou counties, Cal.	55,399	29
Nonirrigable	78,205	29	Uplands	117,573	61
PRIVATE.			Lowlands	74,228	39
Total	207,778	....	Upper division	46,351	24
Irrigable	138,362	67	Lower division	145,443	76
Nonirrigable	69,416	33	Under existing canals	10,000	5
PUBLIC.			Above existing canals	181,40	95
Total	63,228	....	Subscribed private lands	110,362	80
Irrigable	53,439	86	Unsubscribed private lands	28,000	20
Nonirrigable	8,789	14			

EXPENDITURES.

The expenditures on the Klamath project are summarized in the following table:

Expendtures, according to physical features, Klamath project to June 30, 1906.

Features.	Engineering and administration.	Building.
Irrigation structures:		
North Poe Valley canal	$383.00	....
South Poe Valley canal	1,334.48	$738.26
Main canal and tunnel	17,231.44	179,218.66
East Branch canal	405.25	3,009.26
Distributing system	876.00	3,317.37
Drainage system	269.65	....
Irrigable lands:		
Farm unit subdivision and soil examination	1,418.00	....
Examination of project as a whole	45,684.72	....
Administration of project as a whole	27,340.86	....
Total	94,943.40	186,283.55
Grand total	....	281,226.95

Expenditures, according to purpose and nature, on Klamath project to June 30, 1906.

[Total, $281,226.95.]

	Services.	Traveling.	Subsistence.	Equipment.	Materials.	Supplies.	Rent and storage.	Forage.	Job work.
Engineering:									
Examination	$11,424.25	$2,730.28	$3,254.91	$3,169.63	$2.00	$2,289.71	$276.47	$262.02	....
Survey and inspection	21,628.00	2,954.76	5,873.98	6,109.05	....	2,264.41	145.57	1,786.83	....
Design	2,589.21	231.00	195.03	114.64	....	....	31.14	....	....
Subdivision	162.40	85.00	....	....	....	22.25	....	....	....
Building:									
Rights and property	4,361.67	494.75	124.93	3.40	149,000.00	328.90	24.00	25.51	....
Building	5,750.55	326.38	1,665.42	1,220.31	60.74	1,200.17	83.50	623.62	$20,989.70
Administration	19,024.01	1,666.82	1,091.64	1,567.92	....	2,129.70	1,532.39	328.38	....

SOUTH DAKOTA.

BELLE FOURCHE PROJECT.

GENERAL STATEMENT.

The principal data relating to the Belle Fourche project are summarized below:

Summary of principal data relating to Belle Fourche project.

Counties: Butte, Meade.
Longitude: 44° 40′.
Latitude: 103° 30′.
Townships: 6 to 10 north; range 3 to 8 east, Black Hills meridian.
Average rainfall: 14 to 19 inches.
Watershed area: 4,300 square miles.
Estimated annual run-off of Belle Fourche River: 400,000 acre-feet; no prior rights.
Range of temperature: Maximum, 100°; minimum, 30° below zero.
Average elevation: 2,600 to 3,000 feet above sea level.
Principal products: Alfalfa, cereals, vegetables, and hardy fruit, sugar beets, and potatoes.
Nearest railroads: Chicago and Northwestern; Chicago, Burlington and Quincy.
Nearest stations: Belle Fourche, 1½ miles from headworks; Sturgis, 20 miles from lower body irrigable lands.
Principal market: Mining towns in Black Hills, Omaha, Chicago, Minneapolis.
Proportion of public land: 50 per cent.
Character of soil: North side, heavy clay; south side, sandy loam.
Value of irrigated land: $60 to $80 per acre.
Date of completion: September, 1909.
Irrigable area: 100,000 acres.
Duty of water: 2 feet.
Inlet canal: 6¼ miles long; capacity, 1,635 second-feet.
Kind of headworks: Diversion dam in Belle Fourche River, with concrete regulator and 400-foot spillway.
Reservoir area: 8,010 acres.
Capacity of reservoir: 203,770 acre-feet.
Height of dam: 115 feet.
Length of dam: Top, 6,200 feet.
Dam type: Earth with concrete face.
Length of distributing canals: 100 miles, 57 on north and 43 on south side.
Length of laterals: 125 miles.

The Belle Fourche project contemplates the diversion of the waters of Belle Fourche River at a point below the mouth of Redwater River and the storage of the same in the Belle Fourche reservoir, to be formed by a dam across Owl Creek near the mouth of Dry Creek, about 10 miles northeast of Belle Fourche, S. Dak. This reservoir will be of sufficient capacity to store water for the irrigation of all lands under the project.

A telephone system has been planned to connect all parts of the project and the first section has been completed by W. H. Crumb & Co., of Chicago, Ill., to whom the contract was awarded. A permanent camp has been established at the head of the inlet canal for the use of the Government forces. These buildings will be used by the gate keeper or superintendent. All necessary rights of way for the project have been secured.

In the following table are listed the contracts entered into for building work on the Belle Fourche project. This list includes all contracts for excavation, embankment, masonry, and erection of structures, but does not include materials such as cement, steel, timber, etc.

Contracts for building work on Belle Fourche project to June 30, 1906.

No.	Contractor.	Feature.	Estimated total value.[a]	Payments to June 30, 1906.	Per cent paid.
36	S. R. H. Robinson	Main canal, division 1	$99,937.00	$50,294.63	50
37	Widell-Finley Co[b]	Main canal, division 2	107,200.00	57,803.08	54
58	W. H. Crumb & Co.	Telephone	4,152.00	4,061.61	100
73	Orman & Crook	Dam, north and south canals	1,003,299.25	22,712.92	2

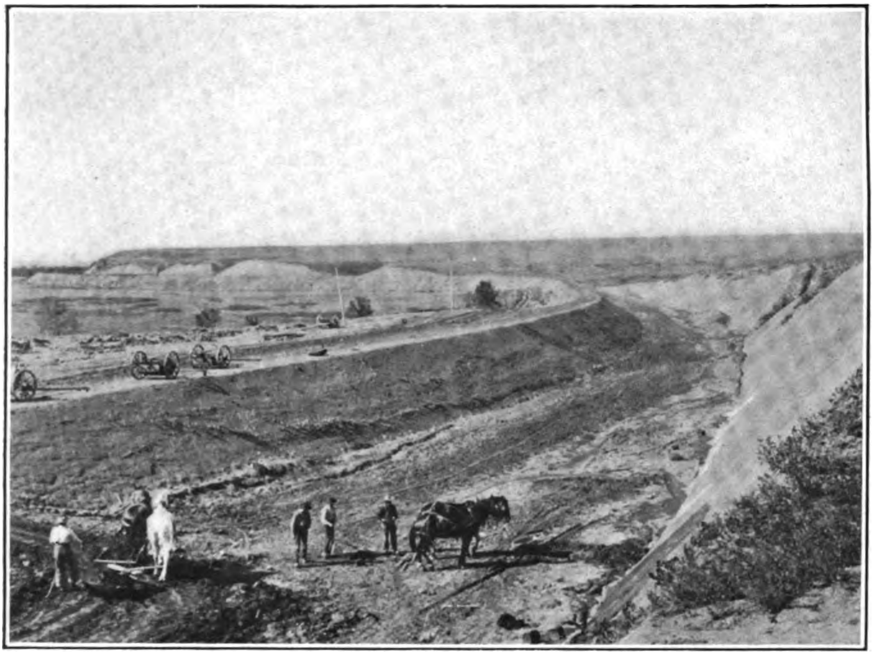
[a] For a discussion of advance estimates and final costs see page 51.
[b] Contractor in default. Work carried on by force account.

DIVERSION DAM AND INLET CANAL.

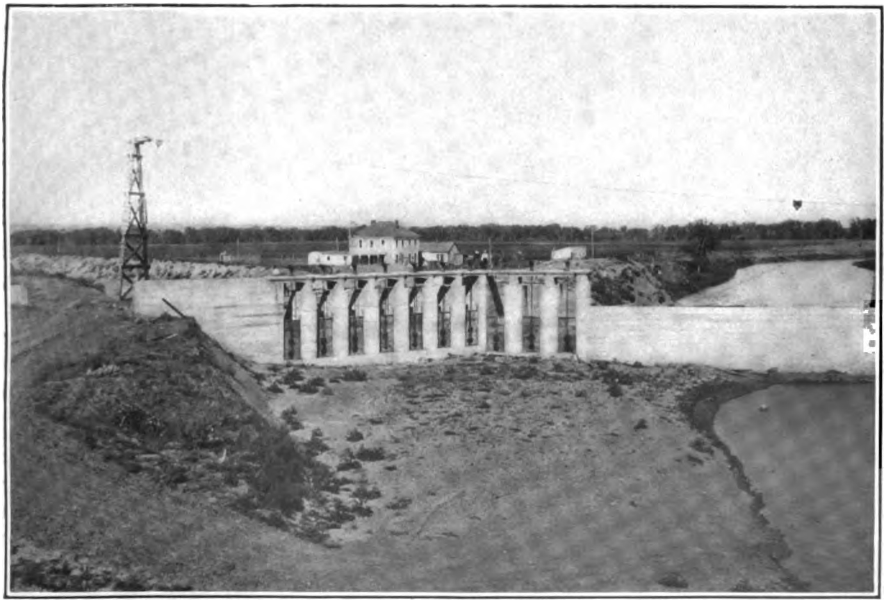
Plans showing location and dimensions of the Inlet canal and schedules of bids received were published in the Fourth Annual Report of the Reclamation Service. This canal is to be 6½ miles in length with a bottom width of 40 feet, side slopes 1½ : 1, and is designed for a capacity of 1,635 second-feet. Work has been carried on during the present season under two schedules. Contract for schedule No. 1, diversion dam and structures, was awarded to S. R. H. Robinson, of St. Louis, Mo., and the contract for schedule No. 2, approximately 800,000 cubic yards excavation, was awarded to the Widell-Finley Company, of Mankato, Minn. The right of way was purchased for the entire length, as the location lay entirely within deeded land which had been taken up prior to October 2, 1898.

The diversion dam and all structures on the Inlet canal are to be of reenforced concrete (Pls. LXXXVII and LXXXVIII). Plans and descriptions of the dam and regulator gates are given in the Fourth Annual Report. The contractor has an efficient equipment at the dam site. A cableway 700 feet in length crosses the river over the diversion dam. At the south end of this is located a cubical concrete mixer, with gravel and sand bins, and cement storage shed. A rock crusher has been placed near the Deadwood tunnel on the Chicago and Northwestern Railway. The rock used is a limestone obtained in the vicinity. The crushed rock is transported to Belle Fourche by rail and thence to the structures by wagons. Other equipment, consisting of a Smith concrete mixer, hoisting engines, derricks, etc., is located at Crow Creek—where a concrete sluice and spillway are being built. Work has been carried on throughout the season, though operations have been much hindered by the floods of spring and early summer.

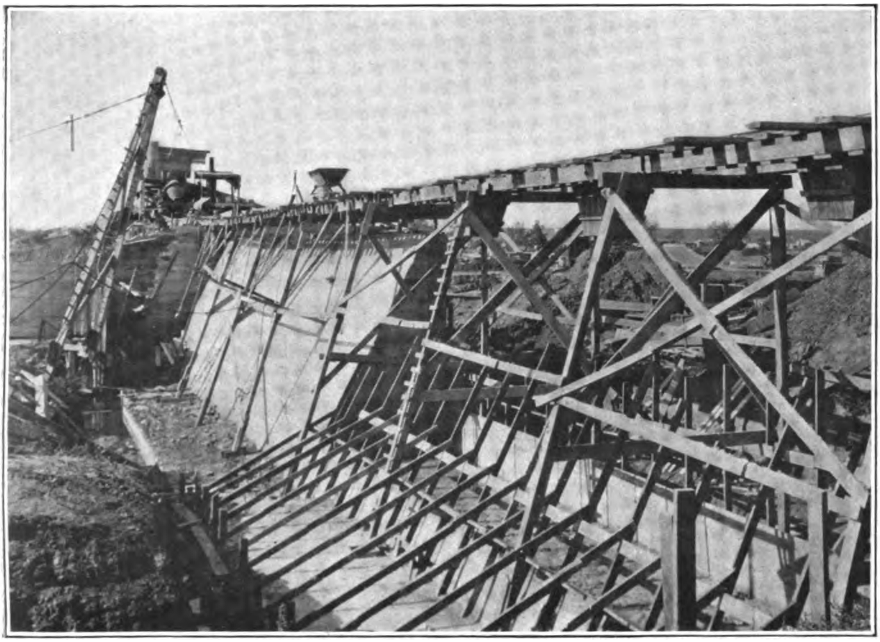
During the latter part of 1905 very little progress was made on schedule No. 2, Inlet canal excavation, on account of unfavorable weather conditions, and it was found necessary to extend the contract time from March 1 to May 30, 1906. On March 7, 1906, the contractor—The Widell-Finley Company—defaulted and relinquished the work to the Government. Bids were asked for the completion of the work, but as none were received on May 29, the date set for opening the proposals, the Secretary of the Interior ordered the work to be finished by force account. This work has been carried on by the United States since March 7, 1906. The contractor's equipment—which has been taken by the Government—consists of two steam shovels, with cars, tracks, etc.



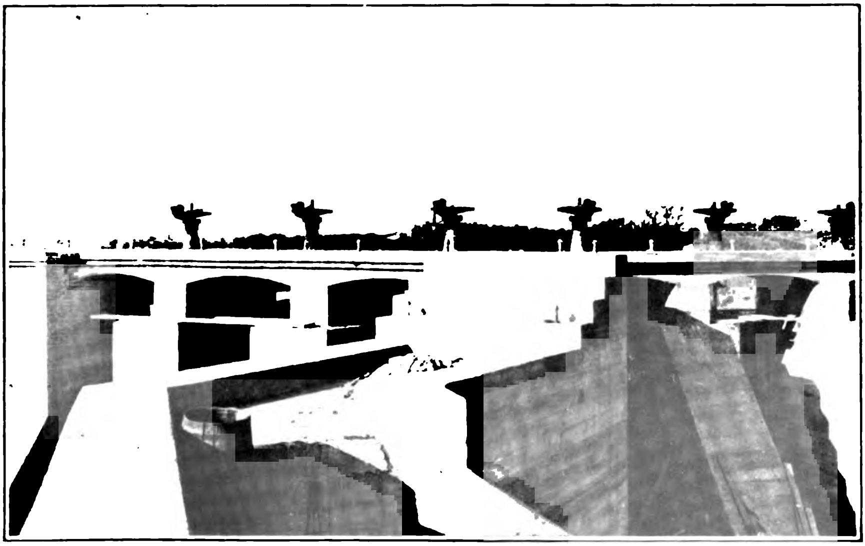
A. INLET CANAL, BELLE FOURCHE PROJECT, SOUTH DAKOTA.



B. DIVERSION DAM AND HEADWORKS IN BELLE FOURCHE RIVER, BELLE FOURCHE PROJECT, SOUTH DAKOTA.



A. CROW CREEK WASTEWAY AND SLUICE, INLET CANAL, BELLE FOURCHE PROJECT, SOUTH DAKOTA.



B. REGULATOR AT HEADWORKS OF INLET CANAL, BELLE FOURCHE PROJECT, SOUTH DAKOTA.

BELLE FOURCHE RESERVOIR AND DAM.

A description and plans of the Belle Fourche reservoir and dam are given in the Fourth Annual Report. A reservoir will be formed by the dam across Owl Creek, and will have a capacity of approximately 200,000 acre-feet. The area within the reservoir limits will be about 8,000 acres—the greater part of which is Government land. One section of school land and 480 acres of deeded land have been purchased, and there remain approximately 480 acres to be obtained in the same way.

The contract for building the dam was awarded November 14, 1905, to Orman & Crook, of Pueblo, Colo. Work was at once commenced and has continued without interruption to date. The contractor's equipment for earthwork at present consists of one 2½-yard Vulcan steam shovel, and 4 trains of 10 cars each, four 12-ton locomotives; 2 elevating graders, a sufficient number of teams for handling earth, and 2 steam rollers for rolling material in embankments. The dam should be completed by September 1, 1909, the date specified in the contract. It may, however, be possible to use the reservoir after the spring of 1908 for the storage of sufficient water for the irrigation of land under the outlet canals and completed laterals. For the irrigation of lands under the south canal during the spring of 1907 it is proposed to excavate a small canal, approximately 3 miles in length, connecting Dry Creek with the south canal—the water to be conducted from the river through the inlet canal and Dry Creek.

Borings and test pits at the dam site show that the material is homogenous and compact. An analysis of the earth to be used in the dam was made, and from this the location of borrow pits determined. The material to be used is a compact clay, which is nearly impervious to water.

The structures at the dam consist of outlet conduits with regulating gates to control the delivery of water to the north and south canals, and a semicircular spillway near the northern end of the dam for the disposal of flood waters. The contractors have commenced work on the south conduit, in which will be located the controlling gates for the South canal. This conduit is to be of reenforced concrete. The controlling gates are to be of cast-iron, and operated by ball-bearing machinery.

The contractor's equipment for this work consists of a large cubical concrete mixer at the dam site, and of screening plant, crusher, and traction engines at the gravel pits, which are located near Belle Fourche River, about 6 miles south of the dam.

NORTH AND SOUTH CANALS.

Two outlet canals from the reservoir will supply water to all but 2,900 acres of the 90,000 acres under the project, the 2,900 acres being supplied by the Inlet canal and its laterals. The contract for building the first divisions of both these canals, with the appertaining structures, was let to Orman & Crook, Pueblo, Colo. The contract for the balance of the north and south canals and part of the lateral system will be let during the winter of 1906–7.

The north canal will supply water to the land north of Belle Fourche River and east of Owl Creek. It will be approximately 45 miles in length, and will end at Willow Creek. The total amount of irrigable land covered will be approximately 66,850 acres, of which 3,450 acres are subject to overflow of creeks and rivers during spring floods. The canal will cross Indian and Horse creeks through inverted siphons of reenforced concrete. Very little work has been done on this canal, and it will be necessary to employ large forces during the fall and spring in order to complete it during the summer of 1907.

The south canal will supply water to the lands south of Belle Fourche River, and between Owl Creek and the river on the north side. It will be approximately 45 miles in length and will end at Ninemile Creek. The total amount of irrigable land covered will be approximately 28,240 acres, of which 7,595 acres are located between the reservoir and the river, and 20,645 acres are on the south side of the river. All structures, including conduits across Belle Fourche River and Whitewood Creek, are to be of reenforced concrete. A portable concrete mixer has been placed upon the work, and the head-gates for laterals, etc., are being built as work on the main canal proceeds.

DISTRIBUTION SYSTEM.

A description of the lateral system was given in the Fourth Annual Report. Location surveys have been carried on during the season and contracts will probably be let during the winter of 1906–7.

BRIDGES.

Bids were received May 15, 1906, for the erection of five highway bridges and the contract awarded on June 18, 1906, to the Canton Bridge Company, Omaha, Nebr. Bridges are to be single span, steel trusses, 72 feet center to center, designed for a load of 100 pounds per square foot. The following table shows bids received:

Bids opened May 15, 1906, for bridges, Belle Fourche project.

[Specifications, No. 87.]

	Canton Bridge Co., Omaha, Nebr.		Black Hills Manufacturing Co., Deadwood, S. Dak.		Campbell-Flagler Bridge Co., Council Bluffs, Iowa.[a]		Clinton Bridge and Iron Works, Clinton, Iowa.	
	Each.	Total.	Each.	Total.	Each.	Total.	Each.	Total.
Schedule A	$1,173	$5,865	$1,387	$6,935	$1,400	$7,000	$1,540	$7,700
Schedule B	1,200	6,000	([b])	([b])	1,395 1,180	6,975 $5,900	1,600	8,000

[a] Informal and with conditions. [b] No bid.

Schedule A, bid according to plans of the United States Reclamation Service.
Schedule B, bid according to plans submitted by bidder.

CEMENT.

All the cement used on the project is manufactured by the Western Portland Cement Company, Yankton, S. Dak. The following table show bids received February 6, 1906, for the delivery at Belle Fourche of 20,000 to 30,000 barrels of cement for use during the seasons of 1906–7:

Bids opened February 6, 1906, for cement, Belle Fourche project.

[Specifications, No. 70.]

Bidder.	Price per barrel.	Place of delivery.
Western Portland Cement Co., Yankton, S. Dak.	$2.43	Belle Fourche, S. Dak.
Illinois Steel Co., (informal), Chicago, Ill.	1.35	Mill, South Chicago.[a]

[a] Freight, Chicago, Ill., to Belle Fourche, S. Dak. $1.43.

IRRIGABLE LANDS.

The total area under the project is approximately 98,000 acres, of which about 90,000 are subject to payment for water—as Government land or under the water users' association. The land lies at an elevation of between 2,600 and 2,900 feet above sea level, and the greater part is rolling prairie, with the exception of some flat lands on Indian and Horse creeks that may require provision for drainage. The soil is of various kinds—on the south side it is a sandy loam and on the north side it ranges from a medium loam to a heavy clay. It is deep and free from rock and gravel. Analyses show a very small amount of alkali and soluble matter. The subsoil for the most part is an impervious clay. Some of the lands under the south canal are underlain by gravel. On most of the lands the depth to bed rock, which is blue shale, is more than 40 feet. The distribution of the lands is shown by the following table:

Lands included in Belle Fourche project.

GENERAL.

	Acres.	Percentages.
Total	155,620	....
Private	67,040	43+
Public	68,080	44−
School (State of South Dakota)	7,220	5−
Title pending (desert entries and homestead entries made before segregation)	13,280	8−
Irrigable	101,967	66−
Nonirrigable[a]	53,653	34+
PRIVATE.		
Total	67,040	....
Irrigable	41,859	63−
Nonirrigable	25,181	37+
PUBLIC.		
Total	68,080	....
Irrigable	44,986	66+
Nonirrigable	23,094	34−
SCHOOL.		
Total	7,220	....
Irrigable	5,515	76+
Nonirrigable	1,705	24−
TITLE PENDING.		
Total	13,280	....
Irrigable	9,607	72+
Nonirrigable	3,673	28−
IRRIGABLE.		
Total	101,967	....
In Butte County	94,859	93+
In Meade County	7,108	7−
Under south canal	30,367	30−
Under north canal	67,730	67
Under inlet canal and lateral	3,870	3+
North of Belle Fourche River	79,322	78+
South of Belle Fourche River	22,645	22−
Under reservoir supply	98,097	97−
Under river supply only	3,870	3+
Overflow land on south side	192	....
Overflow land on north side	3,450	3
Under existing canals	200	....
Subscribed (private)	32,918	79−
Unsubscribed (private)	8,941	21+
Subscribed (school)	5,515	100
Unsubscribed (school)	....	....
Subscribed (title pending)	5,138	54−
Unsubscribed (title pending)	4,449	46+
Private, school, and title pending:		
Subscribed	43,571	76+
Unsubscribed	13,390	24−
NONIRRIGABLE.		
Total	53,653	....
Public	23,094	43+
Private	25,181	47−
School	1,705	3+
Title pending	3,673	7+
IN BUTTE COUNTY.		
Total	139,380	....
Private	55,480	40−
Public	64,480	46+
School	7,220	5+
Title pending	12,200	9−
Irrigable	94,859	70−
Nonirrigable	44.521	30+
IN MEADE COUNTY.		
Total	16,240	....
Private	11,560	71
Public	3,600	22+
School	....	....
Title pending	1,080	7−
Irrigable	7,108	44−
Nonirrigable	9,132	56+

[a] Nonirrigable lands in each case given include all land in farms of private owners and all land in farm entries for public and school lands; thus much is located above the canals, but is included in project farms.

WATER USERS' ASSOCIATION.

The Belle Fourche Water Users' Association was incorporated July 20, 1904, with a capital stock of $3,400,000, divided into 100,000 shares at $34 per share, each share representing 1 acre of land owned by the holder. The usual contract was entered into with the United States October 25, 1905, and was recorded in the office of the recorder of Butte County, S. Dak., August 1, 1906, and in the office of the recorder of Meade County, S. Dak., August 11, 1906. The association maintains an office at Belle Fourche, S. Dak.

TOWN SITES.

One main town site and two village sites have been reserved under the project. These will be surveyed and laid out when the proper time arrives. The main town site is located in sections 20 and 29, T. 9 N., R. 6 E., B. H. M., and the village sites in the NE. ¼ sec. 14, T. 9 N., R. 4 E., and the NE. ¼ sec. 7, T. 8 N., R. 7 E., B. H. M.

EXPENDITURES.

The expenditures on the Belle Fourche project are summarized in the following tables:

Expenditures, according to physical features, on Belle Fourche project to June 30, 1906.

Features.	Engineering and administration.	Building.
Incidental structures:		
Telephone line, 16 miles	$197.62	$4,747.30
Offices		3,559.02
Lodging and boarding houses, barns, etc		3,182.55
Engineer's residence at Belle Fourche dam		970.63
2 Artesian wells, 1,966 feet deep		2,390.59
Sewer and water-supply system		1,077.87
Irrigation structures:		
Diversion weir		
Diversion headworks, sluiceway, and gates	9,519.32	74,314.86
Inlet canal	9,519.32	96,899.35
Belle Fourche reservoir-submerged lands		4,800.00
Belle Fourche dam	7,447.16	15,019.44
North side canal	9,564.86	4,880.76
South side canal and siphon	4,858.48	11,788.66
Distributing system	527.77	
Highway bridges across inlet canal	100.00	196.73
Irrigable lands:		
Farm unit subdivision and soil examination	2,792.54	
Examination of project as a whole	9,931.22	
Administration of project as a whole	22,829.69	
Total	77,287.98	223,827.77
Grand total		301,115.75

Expenditures, according to purpose and nature, on Belle Fourche project to June 30, 1906.

[Total, $301,115.75.]

	Services.	Traveling.	Subsistence.	Equipment.	Materials.	Supplies.	Rent and storage.	Forage.	Job work.
Engineering:									
Examination	$1,679.31	$643.65	$764.82	$967.20		$326.58	$2.13	$121.95	
Survey and inspection	23,781.80	2,839.82	6,130.76	5,763.39	$60.04	2,108.98	11.89	1,293.00	
Design	6,124.16	117.10	414.99	205.44		170.75		2.55	
Subdivision	745.87	99.12	5.10	55.91		21.08			
Building:									
Rights and property	1,165.26	109.10	20.30			14,371.25			
Building	28,366.00	1,063.89	6,687.29	1,588.13	19,417.96	6,327.67	62.06	2,322.54	$142,326.32
Administration	15,928.61	1,986.57	396.25	1,554.86		2,108.78	797.96	56.66	

UTAH.

STRAWBERRY VALLEY PROJECT.

The Strawberry Valley project (Pl. LXXXIX) will provide water for a large area in central Utah, situated from 5 to 15 miles south of Provo. The water will be stored in a reservoir on Strawberry River, about 30 miles east of the irrigable area, and by means of a tunnel 4 miles long will be carried under the divide and emptied into Spanish Fork, from which a canal from 18 to 20 miles long will convey it to the irrigable area.

Work on preliminary structures for this project was authorized on March 6, 1906. This work includes the necessary buildings, repairs on roads, and opening up both portals of the Strawberry tunnel.

The Rio Grande Western Railway Company has built a siding at the nearest railway point, and a small piece of land has been leased on which to erect the necessary buildings and to afford yards for materials in connection with the work. At this point a stable with space for six horses and a house of four rooms have been built.

From the railroad point a wagon road is being built to both portals of the tunnel. This road is through a mountainous district for the entire distance, and the construction has included some heavy earth and rock work. This work has been done almost entirely by men who are members of the Water Users' Association, and the officers of that association have assisted materially in securing and maintaining an effective force on the work. When completed the road will have such an alignment that a 6-horse team can pass all curves. The maximum grade will be 7 per cent, and on over more than 85 per cent of the length of the road the grade will not exceed 5 per cent. All but about 3 miles of the road is located through vacant public lands. This road when completed will undoubtedly be of great value to settlers in the western part of the Uinta Reservation, as it will afford a much shorter and better route from that portion of the reservation to the central markets of Utah than any road now available. As soon as the road work was sufficiently advanced to afford communication with the west portal of the Strawberry tunnel work was begun and is now in progress on temporary camps at that point, though until the road is completed to the camps work on a large scale will not be advisable. A force of men was recently put to work opening up the west portal of the tunnel, and work is progressing quite favorably, considering the equipment for the work.

The plan outlined for the project includes the following structures: (1) A loose rock and earth dam 42 feet high to store the waters of Strawberry River and Indian Creek, forming a reservoir of 100,000 acre-feet capacity in Strawberry Valley; (2) a tunnel 18,900 feet long to convey the water from the reservoir through the rim of the Great Basin to the head of Diamond Creek, a tributary of Spanish

Fork, the latter being a tributary of Utah Lake; (3) a comparatively simple distributing system from Spanish Fork to complete the irrigation of 50,000 acres of lands now partially irrigated from that stream.

Plans for the tunnel (Pl. XC) were finished early in March, 1906. The tunnel will have a finished section of 6½ by 7½ feet, an arched roof, a grade of 3 feet per 1,000, and a capacity of 500 second-feet. A telephone system in connection with the project was planned to extend from both portals of the tunnel to Spanish Fork, where connections could be had with the commercial lines. The distance is about 35 miles, and bids for its construction were opened at the Salt Lake office May 2, 1906, the contract for the work being awarded to E. A. Hess, of Lyons, Iowa, on May 29,1906.

Bids opened May 2, 1906, for telephone system, Strawberry Valley project.

[Specifications No. 82.]

Bidder.	Section 1, about 10 miles.	Section 2, about 28 miles.	Section 3, apparatus complete.	Total.
	Per mile.	*Per mile.*		
E. A. Hess, Lyons, Iowa [a]	$251.95	$283.95	$100.00	$10,570.10
John H. Vorhees, Tucker, Utah [b]	258.00	287.00	162.00	10,778.00
Henry Gardner, Spanish Fork, Utah [c]	315.00	325.00	320.00	12,570.00
W. D. Lovell, Minneapolis, Minn [d]	325.00	372.00	152.00	13,818.00
Pearce, Sneathen & Ahlstrand, Salt Lake City, Utah [e]	440.00	440.00	140.00	16,860.00
Danielson Manufacturing Co., Logan, Utah [f]	531.65	559.85	113.80	21,106.10

[a] Begin work 20 days after award. Complete all in 90 days. Specifies Kellog Co. instruments.

[b] Begin work 15 days after award. Finish in 120 days. No instruments specified.

[c] Begin work 20 days after award. Complete by Aug. 20. Specifies Strawberry Carlson instruments.

[d] Begin work 60 days after award. Complete in 130 days. Instruments not specified.

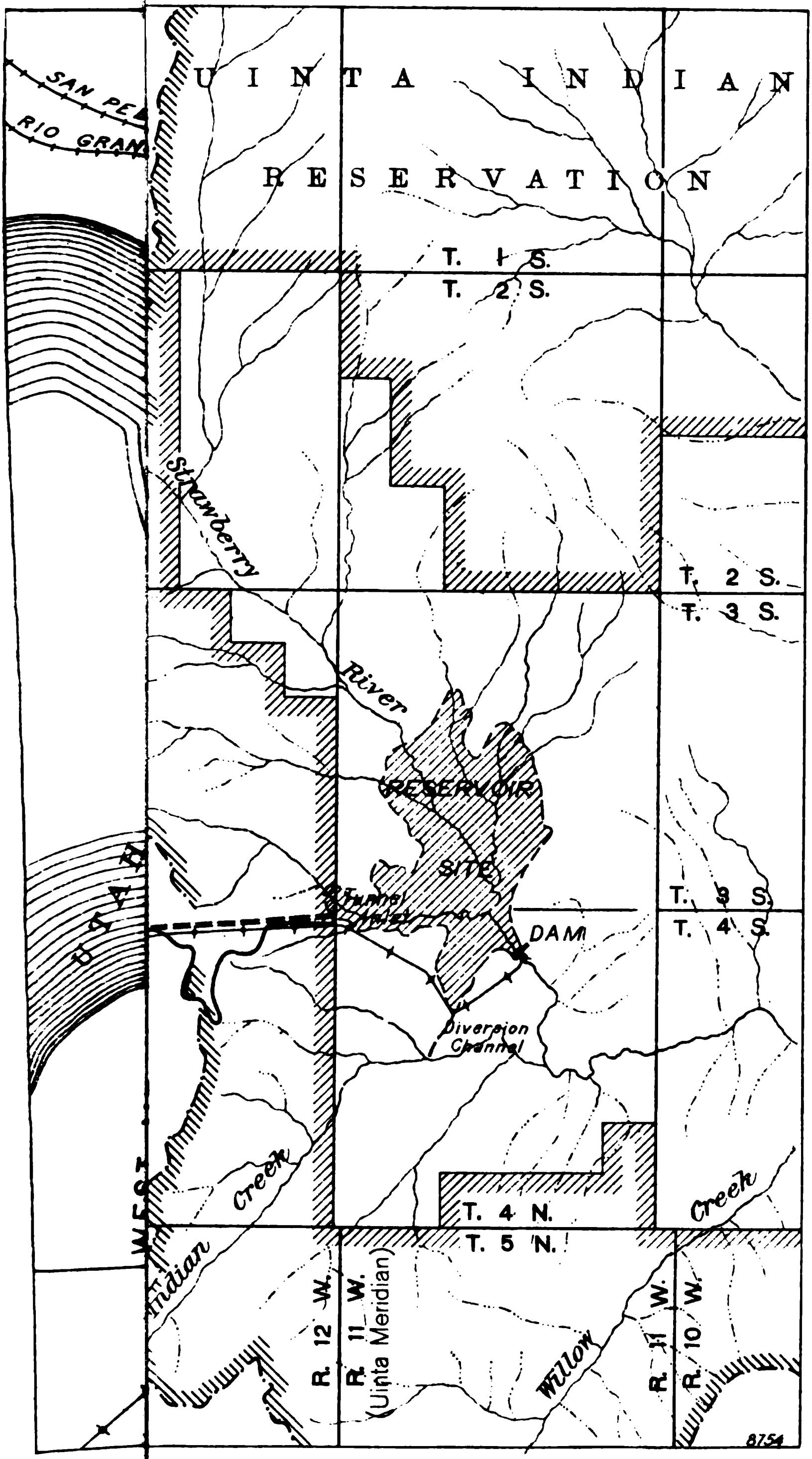
[e] Begin work 30 days after award. Finish by Sept. 1. Instruments not specified.

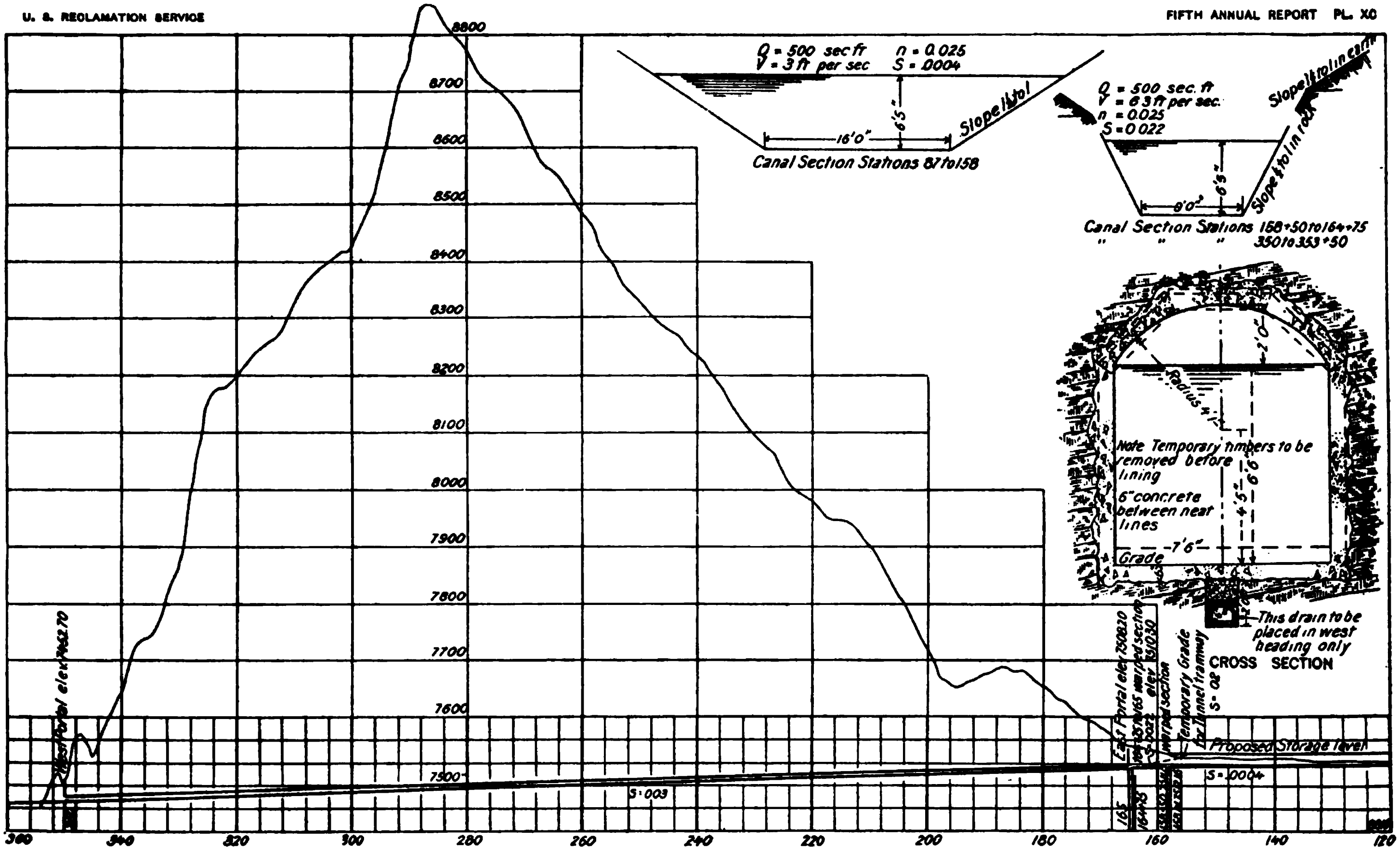
[f] Begin work 20 days after award. Finish in 90 days. Instruments not specified.

Plans for the distributing system and for the storage dam have not been completed, but are in shape to be taken up when required. It is expected that the tunnel construction will be well under way before these works are commenced, as they do not require so much time for their construction as the tunnel.

A complete plane-table survey of the irrigable area is being made, and is well advanced, so that the existing conditions may be studied, and possibilities fully examined before the distributing system is decided upon. The best use of the existing system in the general plan is an important factor. Borings at the storage dam site indicate that no difficulties will be encountered at that structure.

A summary of available hydrographic data in connection with the project to the end of the year 1905 is given in the Fourth Annual Report, page 331. The matter has received further consideration during the past year, and it is found that from July 1, 1905, to June 30, 1906, the total run-off available for storage purposes aggregated 94,500 acre-feet, a result fully justifying the conclusion to construct a reservoir of 100,000 acre-foot capacity. In the irrigation months of the same period, Spanish Fork discharged 72,000 acre-feet, making a total of 165,000 acre-feet, exclusive of the less important supplies from Payson and Spring creeks.


UINTA INDIAN RESERVATION
SAN PE
RIO GRAN
T. 1 S.
T. 2 S.
T. 2 S.
T. 3 S.
Strawberry River
RESERVOIR SITE
Tunnel Inlet
DAM
Diversion Channel
T. 3 S.
T. 4 S.
UTAH
WEST
Indian Creek
Creek
Willow
T. 4 N.
T. 5 N.
R. 12 W.
R. 11 W. (Uinta Meridian)
R. 11 W.
R. 10 W.
8754



PROFILE AND CROSS SECTION OF TUNNEL AND CROSS SECTIONS OF CANAL, STRAWBERRY VALLEY PROJECT, UTAH.

Discharge, in acre-feet, of Strawberry River and Spanish Fork, July 1, 1905, to June 30, 1906.

Month.	Strawberry River.	Spanish Fork.	Total.
July	2,060	2,835	4,895
August	1,700	2,988	4,688
September	1,743	3,529	5,372
October	2,600	3,597	6,197
November	3,200	3,612	6,812
December	2,100	3,363	5,463
January	1,740	3,917	5,657
February	1,527	3,915	5,432
March	1,383	8,657	10,040
April	13,733	21,427	35,160
May	44,898	43,053	87,951
June	17,899	17,262	35,161
Total	94,583	118,155	212,738

The expenditures are summarized in the following tables:

Expenditures, according to physical features, on Strawberry Valley project to June 30, 1906.

Features.	Engineering and administration.	Building.
Incidental structures:		
Diamond Fork road, 12 miles	$735.25	$4,882.25
Telephone line, 18 miles	863.02	
Headquarters:		
Offices	75.00	355.66
Lodging and boarding houses, warehouses, corrals, stables, etc.	35.03	320.00
Irrigation structures:		
Strawberry tunnel	13,075.70	961.20
Irrigable lands:		
Water Users' Association	1,111.05	
Examination of project as a whole	19,476.28	
Administration of project as a whole	3,518.91	
Total	38,890.24	6,519.11
Grand total		45,409.35

Expenditures, according to purpose and nature, on Strawberry Valley project to June 30, 1906.

[Total, $45,409.35.]

	Services.	Traveling.	Subsistence.	Equipment.	Materials.	Supplies.	Rent and storage.	Forage.
Engineering:								
Examination	$2,243.82	$823.10	$241.27	$989.49	$2.20	$917.02	$1,155.49	$124.14
Survey	17,925.93	2,700.04	2,753.68	2,068.66	59.59	954.98	846.27	1,163.48
Design	376.56			25.61				
Building:								
Rights and property	45.00	84.75						
Building	3,867.59	90.75	138.53	496.53		1,520.46	74.00	201.50
Executive	2,457.22	391.10		120.33		550.26		

PROPOSED BEAR LAKE PROJECT.

The proposed Bear Lake project involves the entire Bear River drainage, and possibly areas in Wyoming and Idaho. In view of the importance attached to the possible development, the hydrographic inquiry has been continued and somewhat extended during the last year, but no detailed surveys have been made. The general conditions are fully described in the Third Annual Report of the Reclamation Service, second edition. The expenditures on the work in this region are summarized in the following table:

Expenditures, according to purpose and nature, on proposed Bear Lake project to June 30 1906.

[Total, $18, 718.34.]

	Services.	Traveling.	Subsistence.	Equipment.	Supplies.	Rent and storage.	Forage.
Engineering;							
Examination	$11,846.99	$1,590.84	$2,556.53	$1,179.27	$874.12	$56.89	$327.40
Survey	221.83						
Administration	48.68	5.70					

PROPOSED UTAH LAKE PROJECT.

The proposed Utah Lake project is fully described in the Third Annual Report, second edition. This project is not considered feasible at present and all active work has been discontinued. The expenditures are summarized in the following table:

Expenditures, according to purpose and nature, on proposed Utah Lake project to June 30, 1906.

[Total, $34, 040.05.]

	Services.	Traveling.	Subsistence.	Equipment.	Materials.	Supplies.	Rent and storage.	Forage.
Engineering;								
Examination	$21,693.14	$3,812.31	$3,801.52	$1,267.22		$2,500.59	$192.83	$610.40
Survey	25.00	16.15		9.72	$2.44	6.55		
Rights and property						3.50		
Administration	41.68	57.00						

WASHINGTON.

OKANOGAN PROJECT.

GENERAL STATEMENT.

The principal data relating to the Okanogan project are summarized below:

Summary of principal data relating to Okanogan project.

County: Okanogan.
Latitude: 48° 30′ N.
Longitude: 119° 40′ W.
Township: 34 N., R. 26 E., W. M.
Irrigable area: 10,634 acres.
Watershed area: 140 square miles.
Average rainfall: 8 inches.
Range of temperature: Maximum 105°, minimum 10°.
Average elevation: 1,000 feet.
Principal products: Fruit, hay, nuts, vegetables, and grain.
Nearest railroad: Great Northern.
Nearest station: Republic (50 miles).
Principal market: Local.
Kind of headworks: Concrete weir.
Reservoir area: 700 acres: 500 in Conconully reservoir. 200 in Salmon Lake reservoir.
Capacity of reservoirs: 18,000 acre-feet.
Duty of water: 3 acre-feet per acre (diverted).
Height of dam: 83 feet.
Length of dam: 470 feet.
Type of dam: Earth embankment.
Length of main canals: 20 miles.
Length of laterals: 43 miles.
Per cent public land: 10.
Character of soil: Volcanic ash, sand, and gravel.
Value of irrigated land: $100 to $300 per acre.
Date of completion of project: 1907.

The Okanogan project (Pl. XCI) will provide water for the irrigation of about 8,650 acres of land in Okanogan County, Wash. The water supply is to be obtained from Salmon River, a stream which drains about 152 square miles in the eastern foothills of the Cascade Mountains. It is estimated that Salmon River will furnish sufficient water for the irrigation of 10,000 acres. The following table gives the recorded flow of Salmon River:

Flow of Salmon River at Malott, Wash.

	1903. Apr. 12 to Dec. 31.	1904. Jan. 1 to Dec. 24.	1905. Approximate.	1906. Jan. 1 to June 30.
Run-off in acre-feet	28,543	56,460	41,720	22,070
Maximum discharge in second-feet	429	577	410	385
Minimum discharge in second-feet	16	11	7	8
Mean discharge in second-feet	54.5	79.3	57.1	61

The irrigable lands have an elevation of 850 to 1,350 feet above sea level, and lie in a series of benches sloping toward Okanogan River. The soil is mainly sand, light loam, and volcanic ash. Irrigated lands in alfalfa yield a profit on a valuation of $100 per acre, and lands in fruit or nuts, for which the soil is especially adapted, often yield profits on a much higher valuation. Without irrigation the lands are practically worthless.

About 1,425 acres are at present under private irrigation from Salmon River. The water rights of appropriators have been defined by a mutual agreement under which those having a full water right limit their claim to 3 acre-feet per acre for the land they actually irrigate, and those who are at present unable to get water throughout the entire season limit their claim to 3 acre-feet per acre for two-thirds of the number of acres at present irrigated. Under this agreement the aggregate vested rights in Salmon Creek are entitled to 4,050 acre-feet during the entire season, leaving sufficient unappropriated water in a dry year for the irrigation of about 8,500 acres.

The field operations and other work done during 1903, 1904, and 1905 have been described in the Second, Third, and Fourth Annual Reports of the Reclamation Service. During the summer and fall of 1905 field investigations resulting in the present definite plan for storage works and main canal were carried on, and during the succeeding winter plans and specifications were prepared.

The lands under the project have been classified and a general scheme of distribution system has been outlined.

Office buildings, project engineer's cottage, assistants' dormitory, mess house, and barn have been built and water supply and sewerage systems have been installed.

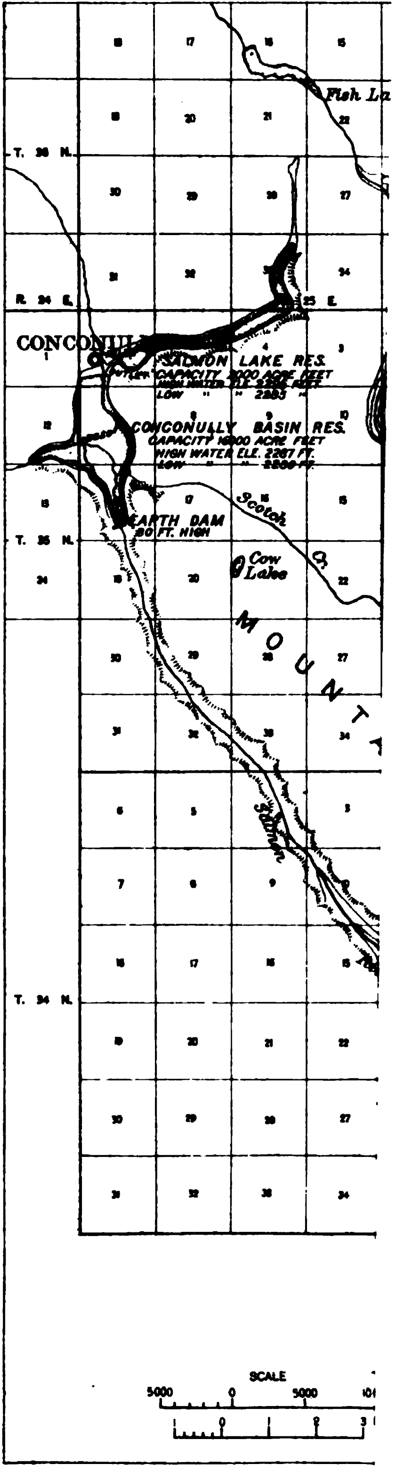
RESERVOIRS.

To utilize the entire flow of Salmon River in years of low run-off a total storage capacity of 13,000 acre-feet is necessary. As it is considered desirable to hold over from a low to a high year as much water as practicable the storage works, Salmon Lake reservoir and Conconully reservoir (Pl. XCII), have been planned for a total capacity of 18,000 acre-feet. With this capacity it is believed that the minimum amount of water available for any one year will be 36,000 acre-feet except in case of two successive low years.

Salmon Lake reservoir, a natural lake about 3½ miles long, immediately east of the town of Conconully, is on a small branch of the North Fork of Salmon River. It has an available capacity of 2,000 acre-feet, the low-water elevation being 2,285 feet and high water 2,295 feet above sea level. It will be necessary to excavate an inlet canal about 1,500 feet long and to build a small concrete outlet structure, with provision for flashboard control.

Conconully reservoir, immediately south of the town of Conconully, will be created by building an earthen dam across Salmon River below the junction of the North and West forks. The capacity of the reservoir will be 16,000 acre-feet. The dam will have a maximum height of 83 feet and a length of 470 feet. High-water elevation is 2,287 feet above sea level, and maximum draft is 57 feet. The outlet will be through a reenforced concrete conduit of 4½ feet inside diameter, which is controlled by a 36-inch cast-iron gate.

U. S. RECLAMATION SERVICE.



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On June 27, 1906, only one bid was received for building the necessary storage works. The total bid was $164,153.75, and as this was deemed excessive it was rejected.

Bid opened June 27, 1906, for storage works, Okanogan project.

[Specifications No. 89.]

Work or material	Quantity.	Mathew P. Zindorf, Twisp, Wash.	
		Rate.	Amount.
Clearing of Conconully reservoir ... acres	[a] 300	$75.00	$22,500.00
Clearing and grubbing Conconully dam site ... do	6	150.00	900.00
Stripping dam site spillway, waste channel, and burrow pits ... cu. yards	5,000	.60	3,000.00
Excavation of cut-off trenches:			
Class A ... do	3,000	.95	2,850.00
Class B ... do	2,000	1.85	3,700.00
Excavation of outlet works:			
Class 1 ... do	100	2.30	230.00
Class 2 ... do	2,900	.75	2,175.00
Excavation for dam embankment:			
Class 1 ... do	4,000	2.20	8,800.00
Class 2 ... do	155,000	.55	85,250.00
Excavation for waste tunnel ... do	1,500	6.25	9,375.00
Puddling ... do	300	1.00	300.00
Concrete:			
Class A ... do	1,030	12.00	12,360.00
Class B ... do	600	16.65	10,489.50
Vitrified pipe drains in spillway channel:			
6-inch ... feet	140		
8-inch ... do	345	([b])	1,984.25
10-inch ... do	370		
Riprap ... cu. yards	160	1.50	240.00
Total			164,153.75

[a] More or less. [b] Lump sum.

CANALS AND DISTRIBUTION SYSTEM.

The supply from the Salmon and Conconully reservoirs will follow the natural channel of Salmon River for about 12 miles to the point of diversion at an elevation of 1,371 feet. The lands to be irrigated are reached about a mile below the point of diversion. There will be about 20 miles of main canal varying in capacity from 100 to 30 second-feet, and about 40 miles of canal with a capacity of less than 30 second-feet.

Bids for the main canal were to have been opened on June 27, 1906, but on that date only one bid was received. As this bid was deemed excessive it was rejected.

Bid opened June 27, 1906, for main canal and appurtenant structures, Okanogan project.

[Specifications No. 89.]

Work or material.	Quantity.	Mathew P. Zindorf, Twisp, Washington.	
		Rate.	Amount.
Excavation:			
Class A ... cubic yards	90,000	$0.46	$41,400.00
Class B ... do	5,000	.60	3,000.00
Class C ... do	20,000	1.45	29,000.00
Class D ... do	400	.45	180.00
Puddling ... do	300	1.00	300.00
Concrete:			
Class A (canal lining) ... do	200	14.45	4,190.50
Class B (structures) ... do	410	18.00	7,380.00
Riprap ... do	200	1.50	300.00
Total			85,750.50

CEMENT AND GATES.

Proposals for 8,000 barrels of cement, 2,000 barrels of which is for the Okanogan project, were opened on May 17 and contract was awarded to the Pacific Portland Cement Company, of San Francisco, Cal.

Proposals for gates and gearing for Conconully dam were received on April 16, and contract was awarded to the Chapman Valve Company, of Indian Orchard, Mass. The following is a tabulation of bids received, all for delivery at Brewster, Wash.:

Bids received April 16, 1906, for gates and gearing for Conconully dam.

Chapman Valve Company, Indian Orchard, Mass	$1,519
Crane Company, Chicago, Ill	1,872
Columbia Engineering Works, Portland, Oreg	1,910
Moran Brothers, Seattle, Wa	2,256
Coffin Valve Company, Boston, Mass	2,552

WATER USERS' ASSOCIATION.

The Okanogan Water Users' Association was organized in October, 1905, and through this organization all required private lands have been committed to the project.

PURCHASE OF LANDS AND RIGHT OF WAY.

Agreements to sell have been obtained from practically all the owners of lands necessary to be acquired for the Conconully reservoir. The greater portion of these agreements have been approved by the Secretary, but no actual purchases have been consummated. The estimate of $30,000 for the acquisition of these lands will probably not be exceeded.

The lands through which the main canal will pass were all patented subsequent to 1888, consequently it has been unnecessary to acquire right of way by purchase.

IRRIGABLE LANDS.

The distribution of the irrigable lands is shown by the following table:

Lands included in Okanogan project, Washington.

	Acres.	Percentages.		Acres.	Percentages.
GENERAL.			IRRIGABLE.		
Total	14,234		Total, all in Okanogan County	10,634	
Private	11,422	80+	North of Salmon River	9,474	90-
Public	2,812	20-	South of Salmon River	1,160	10-
Irrigable	10,634	75-	Under existing canals	1,350	13-
Nonirrigable	3,600	25+	Above existing canals	9,284	87+
PRIVATE.			Public	1,070	10-
Total	11,422		Private	9,564	90+
Irrigable	9,564	84-	Subscribed (private)	8,757	82-
Nonirrigable	1,858	16+	Unsubscribed (private)	807	8+
			NONIRRIGABLE.		
PUBLIC.					
Total	2,812		Total, all in Okanogan County	3,600	
Irrigable	1,070	38	Public	1,742	48+
Nonirrigable	1,742	62	Private	1,858	52-

EXPENDITURES.

The expenditures on this project are summarized in the following tables:

Expenditures, according to physical features, on Okanogan project to June 30, 1906.

Features.	Engineering and administration.	Building.
Incidental structures:		
Office quarters, corrals, etc	$323.03	$2,176.97
Irrigation structures:		
Inlet flume	25.00	....
Salmon Lake reservoir, lands submerged	10.00	....
Outlet works and canal	50.00	....
Conconully reservoir, lands submerged	450.00	....
Conconully dam and spillway, waste tunnel and channel	1,000.00	....
Conconully outlet works	200.00	....
Diversion weir	50.00	....
Main canals and distribution system	2,985.68	....
Irrigable lands:		
Farm-unit subdivision and land classification	1,553.11	....
Examination of project as a whole	20,767.33	....
Administration of project as a whole	4,240.13	....
Total	31,654.28	2,176.97
Grand total	....	33,831.25

Expenditures, according to purpose and nature, on Okanogan project to June 30, 1906.

[Total, $33,831.25.]

	Services.	Traveling.	Subsistence.	Equipment.	Materials.	Supplies.	Rent and storage.	Forage.
Engineering:								
Examination	$958.07	$218.55	$158.40	$168.68	....	$276.24	....	....
Survey	10,246.97	1,634.31	2,073.80	2,629.70	$4.50	2,881.99	....	$237.99
Design	1,341.30	85.15	16.35	16.80	....	46.13	....	....
Subdivision	939.73	155.55	157.96	....	....	36.34	....	26.72
Building:								
Rights and property	263.00	93.55	48.75	....	....	....	....	67.60
Building	428.00	....	14.07	15.00	1,067.99	174.90	....	4.11
Administration	4,823.23	860.10	267.67	446.45	....	865.48	$80.12	....

YAKIMA DISTRICT PROJECTS.

GENERAL STATEMENT.

The Yakima district projects are situated in the basin of Yakima River in south-central Washington, and extend over an area 160 miles long. They include the Kittitas, Tieton, Wapato, Sunnyside, and Benton projects, named in the order of their occurrence from upper end of the Yakima Valley. Active investigation of these projects was begun in the spring of 1905, and operations up to October, 1905, were reviewed in the Fourth Annual Report. Preliminary reports and estimates of cost of all the above-named projects, except the Wapato, were completed in October, 1905, at which time it was decided that the Kittitas and Benton involved expenditures too large to warrant further active investigation and that further work should be concentrated on the Tieton and Sunnyside and on the adjustment of the existing water rights in the valley.

ADJUSTMENT OF WATER RIGHTS.

The adjustment of water rights, dealing as it did, with more than 50 appropriators on Yakima and Naches rivers, whose claims to water conflicted and overlapped at many points, was regarded as the crucial test of whether or not Government work should be undertaken in the Yakima Valley. The approval of any project in the Yakima Valley was made conditional on the appropriators signing agreements to so limit their claims to water that the aggregate diversions would not exceed the low-water flow of the river, which, including return flow from canals, afforded about 2,000 second-feet for irrigation. The basis of the adjustment was a limitation for August and all previous months of the irrigation season to the amount actually diverted in August, 1905, for September to two-thirds that amount, and for October to one-half that amount. This was not entirely achieved but it was closely approximated, as is indicated in the table below, wherein it will be noted practically 95 per cent of all claims to water for irrigation purposes have been defined by agreement.

Adjustment of water-right claims from Yakima River and main tributaries.

Name of ditch.	Average diversions, August, 1905.	Defined claims.[a]	Flow latter part of August, 1905.[b]	Partially defined claims.[c]	Estimated requirements of canals on basis of acreage.
KITTITAS VALLEY.	*Second-feet.*	*Second-feet.*	*Second-feet.*	*Second-feet.*	*Second-feet.*
Ellensburg Water Co	125	124.00			
The West Side Irrigation Co	66	62.00			
Olson et al	20	23.00			70
Fogerty	7				7
Bull Canal Co	23				16
Total	241	209.00			23
YAKIMA VALLEY.					
Selah & Moxee Canal Co	78	78.00			
Taylor Ditch Co	17	23.00			
The Moxee Co	32	38.00			
Fowler Ditch Co	23	23.00			
Wm. Granger	3	2.00			
Total	153	164.00			
NACHES VALLEY.					
Selah Development Co	66	105.00			
Clark et al	19			12.50	
Sinclair & Cobb	6	2.00			
Addison Cobb	1	3.00			
Wapatox Ditch Co.	45	50.00			
Foster Naches Canal Co	1				3
Shafer et al. (Lowery)	17				4
Allen et al. (Kelly)	2				5
Upper Scott (Lee et al.)	6			6.00	
La Fortune Ditch Co	7			3.75	
Lower Scott (John Cox et al.)	5			4.00	
Basket Ford or Laswell ditch	4			4.62	
Naches Canal Co. (Gleed)	75	67.25			
John Morrisey et al	4	3.50			
Yakima Valley Canal Co	61	62.50			
Schuller & Rodenbach	4	4.00			
Jno. Schuller (included in No. 26)	1	0.00			
Leach and White	8	6.00			
McCormick & Long	8	5.00			
Chapman et al	6	5.00			

[a] Defined claims are those for which agreements were signed.

[b] Flow latter part of August represents basis of adjustment for Indian Reservation canals and of Sunnyside canal in event of its purchase by the Government, though no agreements were signed.

[c] Partially defined claims represent those canals in which only part of the owners signed agreements.

Adjustment of water-right claims from Yakima River and main tributaries—Continued.

Name of ditch.	Average diversions, August, 1905.	Defined claims.	Flow latter part of August, 1905.	Partially defined claims.	Estimated requirement of canals on basis of acreage.
NACHES VALLEY—continued.	*Second-feet.*	*Second-feet.*	*Second-feet.*	*Second-feet.*	*Second-feet.*
Nelson et al	7	4.50			
Naches & Cowiche Ditch Co	43	40.00			
Broadgage Ditch Co	10	9.12			
Northwest Light and Water Co. (Incorporated) No. 37	6	0.00			
The New Shanno Irrigation Co	30	15.00			
Fruitvale Shanno Irrigation Co	10	10.00			
R. S. and C. Irrigation Canal Co	9	12.00			
Old Union Ditch Co	65	65.00			
City of North Yakima	18	2.00			
F. Rodenbach	0	15.00			
Total	544	469.67		30.87	12
BETWEEN UNION GAP AND KIONA.					
Indian Reservation canal	269		147		
Sunnyside canal	626		650		
Prosser Falls, L. & P. Co	8	30.00			
Northern Pacific Irrigation Co. (Kiona)	32	23.00			
Total	935	53.00	797		
BELOW KIONA.					
Northern Pacific Irrigation Co. (Kennewick)	111	175.00			
Grosscup (The Yakima Co.)	7				30
Amon (Benton Canal Co.)	4				30
Total	122	175.00	797	30.87	60
COLUMBIA RIVER.					
Waste into Columbia River	100				
Grand total	2,095	1,070.67	797	[a]30.87	95

[a] Estimated defined portion, 15.43 second-feet; estimated undefined portion, 15.44 second-feet.

In addition to the adjustment of claims of irrigation companies the several companies developing water power in the valley limited their claims to about the normal low-water flow of the river during August, except that the right was reserved to divert more during other months when same was available. These claims were as indicated in the following table:

Limitation of claims of power companies.

Company.	River.	Low water limitation.
Northwest Light and Water Co.:		*Second-feet.*
Upper plant	Naches	300
Lower plant	do	250
Taylor & Kemp	Yakima	215
Prosser Electric Co	do	
Prosser Falls Land and Power Co	do	

In 1903 and 1904 the Cascade Canal Company constructed an irrigation system to serve lands in the vicinity of Ellensburg, and also built a small crib dam at the mouth of Lake Kachess to secure necessary storage water, as it recognized that the low-water flow of Yakima River was all appropriated. The company has now under irrigation about 5,000 acres of land, its main canal has a carrying capacity, when in repair, of about 150 second-feet, and the capacity of the reservoir as now constructed is about 32,000 acre-feet. In view of the fact that this company had constructed its dam on unsurveyed Government land that had been withdrawn for forestry purposes prior to its incorporation, and in further view of the uncertainty as to its compliance with State requirements in the matter of appropriation of water, its rights at Lake Kachess, which lake the Government intends to utilize as a reservoir, could not be conceded. An amicable adjustment was attempted on the basis of the company paying its proportionate share of the storage which would be created, the United States to deliver to it such water as was required to irrigate all lands lying under the ditch system of the company, this being about 12,000 acres. This plan was rejected by the company on the mere assertion that it was entitled to such storage free of cost. In order to determine the legal status of this company's water rights at Lake Kachess, suit has been brought by the United States in the Federal court.

The Union Gap Irrigation Company filed on the waters of Lake Clealum, and constructed at its mouth a low crib dam that stores 4,000 acre-feet of water for the irrigation of about 2,000 acres of land on the north side of the Yakima River, just below Union Gap. The land upon which this dam is located was owned by this company, but the Government also desired the same land for the larger dam which it proposed to build in order to utilize this lake as a reservoir. In return for the conveyance to the Government, free of lien and incumbrance, of all the land at the mouth of the lake, the Government agrees to deliver into Yakima River for the use of the Union Gap Irrigation Company from 14 to 28 second-feet during the irrigation season, and a reasonable amount for stock purposes during the winter months.

STORAGE.

Surveys to determine storage possibilities in the Yakima Valley were made during the summer and fall of 1905. These surveys indicated that about 800,000 acre-feet of storage could be economically obtained at the present time, and, if necessity arose, probably an additional 100,000 acre-feet could be secured by utilization of some of the smaller lakes, chiefly in upper Clealum watershed.

In the table below are given all important physical data as to reservoirs in the Yakima basin, the heights of dams being those regarded as most economical at the present time. At Bumping Lake and Lake Keechelus higher dams may well be considered should the necessity for additional storage arise.

Reservoir sites in Yakima River basin.

Reservoirs.	Area of drainage.	Mean annual run-off.	Type of dam.	Height of dam.	Capacity of reservoir.
	Sq. miles.	*Acre-feet.*		*Feet.*	*Acre-feet.*
McAllister Meadows	191	580,000	Earth	102	25,000
Bumping Lake	52	188,000	do	45	25,000
Lake Keechelus	57	207.000	do	46	98,000
Lake Kachess	64	219,000	do	73	225,000
Lake Clealum	210	654,000	do	138	426,000
Total	574	1,848,000			799,000

The dam sites at all the reservoirs except McAllister Meadows were explored to determine character of foundation. This work had been completed at the Yakima Lakes, and was in progress at Bumping Lake at the close of the fiscal year. Good material both for dam construction and for foundation was found at all the lakes.

At Lake Keechelus sandstone bed rock was encountered at from 60 to 80 feet below the river bed. At Lake Kachess sandstone bed rock was encountered at a depth of about 50 feet below river bed. At Lake Clealum sandstone bed rock was encountered from 20 to 40 feet below river bed. At Bumping Lake two sites were explored, the lower one proving the better of the two. At this site no bed rock was encountered, but the entire area at depths of 10 to 20 feet is underlain with an indurated conglomerate of sand, gravel, and clay approaching the hardness of rock.

The McAllister Meadows reservoir site is hardly regarded as feasible at this time, on account of its high unit cost, but it has distinct value in connection with the Tieton subproject, and its construction may become a necessity of the future. The amount of land that may be served by the available storage will depend on the duty of water finally developed for this valley. Stored waters will need be drawn on during a period of from eight to twelve weeks in the summer, dependent upon area irrigated. An entirely conservative area would be 300,000 acres, and with improved economy in the use of water and with the possibility of some additional storage in the Clealum basin, it is safe to assume that 400,000 acres may ultimately be added to the irrigated area of the Yakima Valley.

Until some of the larger subprojects of the general Yakima project are carried to completion, no extensive storage will be required. It is deemed essential, however, to provide some temporary storage to meet possible contingencies, and it has been decided to construct temporary crib dams at Lakes Keechelus and Clealum, at which places some character of temporary dam would in any event need to be provided as preliminary to construction of permanent dams. These crib dams are to be about 14 feet in height, and their combined storage capacity will be about 30,000 acre-feet.

The expenditures on this work are summarized in the following table:

Expenditures, according to physical features, on storage for Yakima district projects to June 30, 1906.

Features.	Engineering and administration.	Building.
Bumping rake reservoir	$912.24	$138.40
Clealum Lake reservoir	2,901.15	710.45
Kachess Lake reservoir	2,759.51	655.09
Keechelus Lake reservoir	1,497.24	341.39
Totals	8,070.14	1,845.33
Apportioned as follows:		
Tieton subproject	4,035.07	922.66
Sunnyside subproject	4,035.07	922.67

HYDROGRAPHIC WORK.

Hydrographic work in theYakima Valley consisted of a continuation of all river stations previously established and the addition thereto of a regular station on Tieton River near the point of diversion of the Tieton canal; of the establishment and regular reading of gages on Lakes Clealum, Kachess, and Keechelus; of the establishment and occasional reading of a gage on Bumping Lake and River; of miscellaneous measurements of flow of some of the smaller streams, as Cowichee and Atanum creeks, and of a wide range of canal measurements. During the summer of 1905, when the water-right adjustment was in progress, measurements were taken and gages maintained on practically all the canals in the valley. After the water adjustment had been effected these extensive measurements were not regarded as essential, and for the 1906 irrigation season only the more important canals were observed. It was anticipated, however, that in the event of a shortage of water it would be necessary to resume nearly all canal measurements for the month of August.

In addition to the work outlined above, low-water measurements have been taken on Yakima River, below all irrigation, to determine approximate waste into the Columbia. Other measurements have been taken on Yakima River at the lower end of the Kittitas Valley, where it is proposed to establish a permanent gage, and for several months, during the consideration of the Priest Rapids project, several gages were maintained on Columbia River.

ROADS.

In connection with the construction of the Bumping Lake dam it will be necessary to repair the wagon road which extends up the Naches River about 40 miles, and to extend it about 20 miles up to Bumping Lake. Fortunately this route had been selected for a State highway and arrangements are in progress for its construction by cooperation between the State and Yakima County. The aggregate appropriations for this purpose, however, would be insufficient to complete the road and the United States will expend about $4,000 for this purpose.

In like manner it has been found necessary to improve the existing road in Tieton Canyon and to extend it about 9 miles upstream to facilitate the construction of the canyon division of the Tieton canal.

TIETON PROJECT.

The principal data relating to the Tieton project are summarized below:

Summary of principal data relating to Tieton project.

County: Yakima.
Latitude 46° 30′.
Longitude: 120° 30′.
Townships 12-15, R. 11-19, W. M.
Irrigable area: 24,000 acres.
Watershed area: 240 square miles.±
Average rainfall: 9 inches.
Range of temperature: Maximum 108°, minimum, 0°.
Average elevation: 1,200 to 2,100 feet.
Principal products: Forage, fruit, and hops.

Nearest railroads: Northern Pacific Railroad, North Yakima and Valley Railroad.
Nearest station: North Yakima, Wash.
Principal markets: Seattle, Tacoma, Spokane and east.
Kind of headworks: Concrete diversion dam.
Height of dam: 3 feet.
Length of dam: 150 feet.
Duty of water: Maximum diversion 1 second-foot to 80 acres.
Length of main canal and branches: 63 miles.
Ownership of land: Private.
Character of soil: Volcanic loam.
Value of irrigated land: $100 to $1,000 per acre.

On December 12, 1905, the Secretary of the Interior approved this project and an allotment of $1,000,000 was made for its building, conditional, however, upon a satisfactory adjustment of the water rights. All questions relative to water rights have been satisfactorily settled in the manner stated on page 280.

As soon as it was evident that the question of water rights would be satisfactorily adjusted, the Tieton Water Users' Association was organized. The organization was completed on March 10, 1906, and by July 1, 33,000 acres of land had been subscribed to the association. Much of the land, however, is nonirrigable by reason of character or location above the ditch. Deducting such lands, however, over 95 per cent of the irrigable area had been duly subscribed.

During March, topographic surveys were begun and during the following two months this work was completed, about 84 square miles having been mapped. Location surveys were begun in the Tieton Canyon in April and practically completed by the close of the fiscal year. This canyon division proved to be unusually heavy work, being on steep sidehill its entire length of 12 miles, one-fifth of which distance is in tunnel. A farm unit survey was commenced and practically completed before the close of the fiscal year, as were also the plans and specifications for the canyon division of the canal.

In view of the heavy canyon work necessary an additional allotment of $250,000 was made on June 15. At the close of the fiscal year preparations were just in progress for assembling a board of engineers to pass on the plans and specifications for the first contract covering the canyon division of the work.

The soil on the Tieton project is in great part a sandy loam of basaltic origin and ranges in depth from a few inches to many feet. Climatological records in this region show a favorable mean temperature, a favorable summer heat and a minimum temperature that should not be unfavorable to the dormant period of orchards and vines. The period between frosts is long enough to mature a wide variety of crops. The rainfall is insufficient for more than partial crops and the number of days of sunshine is especially favorable to the stimulation of plant growth.

The lands are generally rolling, and there are few areas that have a large extent of flat surface. They are specially qualified for orchards, and for growing hops, vines, grain, alfalfa, timothy, root, and tuber crops. Even though the district be adapted to fruit growing, a diversity of products will always be raised and it is difficult to indicate the probable ratio of staple crops. The peculiar climate and soil conditions of the locality might make the raising of potatoes for the manufacture of alcohol an industry that would far eclipse the growing of fruit.

The expenditures on the Tieton project are summarized in the following tables:

Expenditures, according to physical features, on Tieton project to June 30, 1906.

Features.	Engineering and administration.	Building.
Irrigation structures:		
Portion of Yakima storage [a]	$4,035.07	$922.66
Irrigable lands:		
Farm unit subdivision and soil examination	763.17	
Examination of project as a whole	13,834.31	
Administration of project as a whole	6,612.44	
Total	25,244.99	922.66
Grand total		26,167.65

[a] See statement of expenditures on Yakima District Storage.

Expenditures, according to purpose and nature, on Tieton project to June 30, 1906.

[Total, $26,167.65.]

	Services.	Traveling.	Subsistence.	Equipment.	Supplies.	Rent and storage.	Forage.
Engineering:							
Examination	$3,292.71	$872.64	$597.39	$123.58	$221.03	$1.75	$76.67
Survey	7,453.34	869.07	1,686.60	731.20	874.70	40.98	553.70
Design	812.44	90.81	15.65	11.89	11.33		1.76
Subdivision	288.52	26.65	73.67	3.86	10.76		51.37
Building:							
Rights and property	606.74	221.09	30.87		50.19		
Building		22.00					
Administration	4,204.98	714.49	192.01	413.99	659.19	201.08	56.95

SUNNYSIDE PROJECT.

The principal data relating to the Sunnyside project are summarized below:

Summary of principal data relating to Sunnyside project.

Counties: Yakima and Benton.
Latitude: 46° 20′.
Longitude: 120°.
Townships: 19 to 24, ranges 8 to 12, W. M.
Irrigable area: 86,900 acres, of which 40,000 acres (approximately) is now irrigated.
Watershed: 3,300 square miles.
Average rainfall: 7 inches.
Range of temperature: Maximum, 110°; minimum, 0°.
Average elevation: 630 to 850 feet.
Principal products: Forage, fruits, and hops.
Nearest railroad: Northern Pacific Railroad.
Nearest stations: Toppenish, Mabton, Prosser, Sunnyside, Granger.
Principal markets: Seattle, Tacoma, and Spokane.
Kind of head works: Concrete diversion dam; 8 or 10 feet high and 500 feet long.
Duty of water: Maximum diversion, 1 second-foot to 80 acres.
Length of main canal: 63 miles.
Length of main laterals: 205 miles.
Power developed: About 1,300 horsepower to be used for pumping.
Public land: Practically none.
Character of soil: Deep, light, volcanic loam.
Value of irrigated land: $100 to $600 per acre.
Beginning of survey: July, 1905.

This project contemplates the purchase of the Sunnyside canal, owned by the Washington Irrigation Company, which now irrigates about 40,000 acres of land. and its development and extension to cover about 45,000 acres additional. The purchase of this canal, with a carrying capacity of 650 second-feet and water appropriations to cover all requirements for its lands, was regarded as the first essential in the adjustment of water rights in the Yakima Valley. Option for its purchase by the Government at $250,000 had been secured, and pending the general settlement of water rights extensions of the option were obtained as required. A preliminary estimate showed that the development of this project by extensions to cover a total of about 85,000 acres was of reasonable cost and in an engineering way entirely feasible. Report on this subject was rendered to the Department by a board of engineers in October, 1905, recommending that the project be built.

In December, 1905, the project was approved, and $750,000 was allotted to it, conditional, however, upon a satisfactory adjustment of the water-right situation. This adjustment was duly effected, as referred to previously in this report.

The Sunnyside Water Users' Association was organized March 10, 1906, and since that date the association has worked steadily to bring in a sufficient acreage of land to warrant proceeding with the work, but up to the close of the fiscal year not to exceed 85 per cent of the lands that would come under the first unit had been subscribed. The conditions are unusual, in that a considerable acreage in small individual holdings is owned by nonresidents outside the State; but unquestionably these lands will eventually be subscribed. Another unusual condition in connection with this project is that with complete development about one-half the lands will own water rights secured from the Washington Irrigation Company, which by the terms of their contract would need be operated in a manner somewhat different from the new lands. Effort has been made to induce the old water-right lands to join the water users' association so as to effect a uniform and harmonious control of the entire property.

Topographic surveys were begun about May 1, 1906, and by the close of the fiscal year about 120 square miles had been mapped. Tentative designs have been prepared for the rebuilding of the diversion dam on Yakima River, the new design contemplating a low concrete overflow weir instead of the movable dam now in place. Some studies have also been made of the drainage situation, which will be an important factor in this project. In the vicinity of Sunnyside drainage is an absolute necessity. The community there found it necessary for the protection of the lands to organize drainage districts under State laws provided for that purpose. Over $30,000 has already been expended in the development of drainage systems. The people have suggested that these systems be taken over by the Reclamation Service and made a part of a general scheme of drainage to be worked out and maintained by the Government.

The original allotment for this project was intended only to provide for purchase of the Sunnyside canal and the commencement of the first unit of work. After the adjustment of water rights, a further allotment of $350,000 was made for this work.

The distribution of the irrigable lands is shown in the following table:

Lands included in Sunnyside project.

	Acres.	Per cent.		Acres.	Per cent.
GENERAL.			IRRIGABLE.		
Total	125,700	100	Total	86,900	100
Private	122,900	98	East of Yakima River	77,900	90
Public	2,800	2	West of Yakima River	9,000	10
Irrigable	86,900	69	Below existing canals	71,400	82
Nonirrigable	38,800	39	Above existing canals	15,500	18
			Requiring siphons	9,000	7
PRIVATE.			Requiring pumps	5,000	6
Total	122,900	100	Public	800	1
Irrigable	86,100	70	Private	86,100	99
Nonirrigable	36,800	30	Owning water right	49,600	57
			Not owning water right	37,300	43
PUBLIC.					
Total	2,800	100	NOT OWNING WATER RIGHT.		
Irrigable	800	28	Total	37,300	100
Nonirrigable	2,000	72	Subscribed	30,300	81
			Unsubscribed	7,000	19

The expenditures on the Sunnyside project are summarized in the following tables:

Expenditures, according to physical features, on Sunnyside project to June 30, 1906.

Features.	Engineering and administration.	Building.
Irrigation structures:		
Portion of Yakima storage[a]	$4,035.07	$922.67
Irrigable lands:		
Farm unit subdivision and soil examination	577.72	....
Examination of project as a whole	10,608.54	....
Administration of project as a whole	4,967.42	....
Total	20,185.75	922.67
Grand total	....	21,111.42

[a] See statement of expenditures on Yakima District Storage.

Expenditures, according to purpose and nature, on Sunnyside project to June 30, 1906.

[Total, $21,111.42.]

	Services.	Traveling.	Subsistence.	Equipment.	Materials.	Supplies.	Forage.
Engineering:							
Examination	$2,865.75	$706.94	$480.89	$104.75	$20.00	$178.50	$63.21
Survey	5,947.72	708.04	1,370.72	583.01	11.51	702.42	444.45
Design	294.87	22.70	15.65	11.89	....	11.32	....
Subdivision	288.51	26.65	73.67	3.86	....	10.76	51.38
Building: Rights and property	606.74	221.08	30.88	5.55	....	50.19	....
Administration	3,392.48	576.43	154.91	333.99	....	531.83	45.94

WAPATO PROJECT.

The Wapato project contemplates the irrigation of about 120,000 acres on the Yakima Indian Reservation south of the Atanum Ridge and along the right bank of Yakima River. A reconnaissance of this area was made in the fall of 1905, from which it would appear that an excellent project of about the magnitude indicated above was possible.

The lands lie particularly well for easy control, the soil is fertile, transportation facilities are good, and the unit cost per acre for development of the project will be low.

At the present time there are several canals in operation on the reservation, irrigating a total of about 17,000 acres, as follows:

Canals in Wapato Indian Reservation.

	Acres.
New Reservation canal	3,000
Old Reservation canal	9,000
Gilbert ditch	4,000
Small ditches	1,000
Total	17,000

The Old and New Reservation canals were constructed with tribal funds, and are maintained by the Government. The New canal was constructed in 1903, at a cost of about $70,000. It is provided with substantial masonry headworks, has a capacity of 700 second-feet, is about 5 miles in length, and has 12 miles of main laterals. It is proposed to utilize this canal by enlarging and extending it. The lower lands of the project, particularly those along the lower stretches of Toppenish Creek, will in all probability require drainage. Any scheme worked out for this project would attempt to absorb all the old canals into the single large system, would install drainage of some character, and would utilize Toppenish and Satus creeks as far as possible to augment the summer water supply for the ditches.

The water supply for the reservation at the present time is ample during flood flow of Yakima River, but during the low-water period it is limited to about 150 second-feet, which is insufficient for lands even now under irrigation. This low-water period is of from 8 to 10 weeks' duration, and storage would therefore be required. To safely provide for summer irrigation of lands now under ditch, about 15,000 acre-feet of storage is required and for the complete project about 200,000 acre-feet is needed.

To properly work out this project it was necessary that some legislation be had which would allow the lands to be disposed of to white settlers. At present the land is held in severalty, 80-acre allotments to each Indian being the rule. By the act of March 7, 1906 (Stat. L., 34, I, p. 53), authority was granted for the disposition of surplus and allotted lands on the reservation. To do this, however, the consent of the individual allottee is required, and it is uncertain whether this can be readily secured. It is now proposed to make a more careful survey and study of the project, with a view of making a definite proposal to the Indians as to the disposal of their lands and as to the cost per acre for irrigating the lands retained by them. This act also requires that if the Reclamation Service adopts an Indian reservation project, it should also provide a summer water supply for the lands now under ditch. To meet this contingency and to provide necessary funds for the investigation of this project an allotment of $100,000 was made on June 16, 1906.

The expenditures on Wapato project are summarized in the following tables:

Expenditures, according to physical features, on Wapato project to June 30, 1906.

Feature.	Engineering and administration.
Irrigable lands:	
Farm unit subdivision and soil examination	$27.35
Examination of project as a whole	602.16
Administration of project as a whole	289.81
Total	919.32

Expenditures, according to purpose and nature, on Wapato project to June 30, 1906.

[Total, $919.32.]

	Service.	Traveling.	Subsistence.	Equipment.	Supplies.	Forage.
Engineering:						
Examination	$127.35	$41.09	$26.12		$9.26	
Survey	265.32	40.93	80.83	$36.14	41.16	$24.78
Administration	147.73	25.10	6.75	14.54	23.16	2.00

PROPOSED KITTITAS PROJECT.

Surveys for the Kittitas project, which contemplates the irrigation of about 60,000 acres in the vicinity of Ellensburg, Kittitas County, Wash., were never carried beyond a preliminary stage. A report and estimate was rendered in October, 1905, which indicated that this project, on account of the expense involved, could not be undertaken at the present time. Four canal routes were investigated, as follows:

(1) From a point on Yakima River just above Easton at an elevation of 2,174 feet. This line required 90 miles of main canal and would carry water to 62,000 acres.

(2) From Lake Clealum at an elevation of 2,128 feet. This route requires 86 miles of main canal and would carry water to 54,000 acres.

(3) From a point on Clealum River at an elevation of 2,025 feet. This route requires 70 miles of main canal and would carry water to 28,000 acres.

(4) From a point on Clealum River at an elevation of 1,975 feet. This line requires 73 miles of main canal and would carry water to 24,000 acres.

The result of the preliminary surveys was to indicate that whatever the route selected the cost per acre for the system would be relatively high. Route 1 is apparently the cheapest and has the further advantage of covering most land, though more careful surveys will be required to determine definitely whether route 1 or 2 is the better. Both routes involve heavy construction in the way of sidehill rock work and siphons under high heads. The lands under this project are adapted to diversified farming, which is now practiced with much success, although the irrigation season is shorter by several weeks than in the lower end of the valley.

The expenditures on the proposed Kittitas project are summarized in the following table:

Expenditures, according to purpose and nature, on proposed Kittitas project to June 30, 1906.

[Total, $6,566.54.]

	Services.	Traveling.	Subsistence.	Equipment.	Supplies.	Forage.
Engineering:						
Examination	$909.65	$247.08	$170.88	$40.86	$66.41	$31.73
Survey	2,137.25	245.90	484.50	206.68	247.61	161.27
Administration	1,055.20	179.29	48.18	103.88	165.42	14.29

PROPOSED BENTON PROJECT.

The Benton project, heretofore called the Ledbetter project, contemplates the irrigation of a large body of land near the mouth of Yakima River. Preliminary surveys indicated that about 210,000 acres could be economically reclaimed. A portion of this area, about 40,000 acres adjacent to Columbia River, may be irrigated by pumping from that stream. The Hanford Irrigation Company has already organized for that purpose, and the Benton project will, therefore, be reduced in area by that amount. Excepting completion of report and estimate, material for which was at hand when last annual report was prepared, practically nothing has been done with this project since preliminary surveys were made.

The large initial outlay, about $2,000,000, needed to carry the main canal to any considerable area of irrigable lands, and the large ultimate cost, about $7,000,000, make it certain that the building of this project must be deferred several years. The project as a whole is feasible and inviting. The land is fertile, the irrigation season is long, transportation facilities are fair even now, and the unit cost per acre is moderate. In addition to transportation facilities afforded by Columbia River and the Northern Pacific Railway, there seems good prospect of another transportation line, the Chicago, Milwaukee and St. Paul Railroad, traversing this region.

Within the limits of this project are 55,000 acres of land that had been selected in 1896 by the State of Washington for reclamation under the terms of the Carey Land Act. Nothing tangible had ever been done by the State toward the reclamation of these lands, and the selection had never been approved by the Secretary of the Interior.

The expenditures on the proposed Benton project are summarized in the following table:

Expenditures, according to purpose and nature, on proposed Benton project to June 30, 1906.

[Total, $10,900.45.]

	Services.	Traveling.	Subsistence.	Equipment.	Supplies.	Rent and storage.	Forage.
Engineering:							
Examination	$1,900.99	$353.07	$233.56	$39.38	$88.94	....	$28.17
Survey	3,148.11	345.07	722.32	309.80	360.23	....	228.46
Subdivision	288.52	26.65	73.67	3.86	10.76	$3.75	51.37
Administration	1,751.64	297.63	79.98	172.45	274.59	83.76	23.72

PROPOSED PALOUSE PROJECT.

Work on this project was suspended prior to June 30, 1905, as stated in the Fourth Annual Report, page 345. Application having been made by various parties interested in this project for a further investigation, Mr. C. E. Grunsky made a careful and complete study of all previous investigations and a personal examination on the ground. In his report of March 10, 1906, to the director he indorsed the recommendation of a previous board of engineers that the project for the present be suspended from further consideration.

The expenditures on the proposed Palouse project are summarized in the following table:

Expenditures, according to purpose and nature, on proposed Palouse project to June 30, 1906.

[Total, $75,834.74.]

	Services.	Traveling.	Subsistence.	Equipment.	Materials.	Supplies.	Rent and storage.	Forage.
Engineering:								
Examination	$4,062.85	$983.89	$555.78	$418.51	....	$1,022.78	$44.93	[illegible]
Survey	33,527.15	5,969.63	6,472.36	6,482.55	$6.09	7,419.83	32.00	[illegible]
Design	560.64	64.80	....	....	....	31.50	....	....
Subdivision	186.11	44.23	....	55.90	....	10.00	....	....
Building:								
Rights and property	170.50	43.26	....	....	....	13.65	....	....
Building	26.00	17.10	....	....	....	....	....	....
Administration	4,176.26	1,119.31	....	28.62	....	2,085.02	43.50	....

PROPOSED PRIEST RAPIDS PROJECT.

A reconnaissance of this project was made in 1905, and the results of the investigation were reviewed in some detail in the Fourth Annual Report. No further work was done on this project until February, 1906, when all field forces were transferred from Yakima because of the seeming impossibility of adjusting the water-right situation in that valley.

During February and March, 1906, surveys were made in the Priest Rapids region to determine best locations for canal lines and to ascertain the acreage that might be reclaimed. From the examination made at that time it was ascertained that the following approximate acreages might be economically covered by ditch.

Irrigable lands, Priest Rapids project.

	Acres.
Along left bank Columbia River by gravity	11,000
Along right bank Columbia River by gravity	36,000
Along left bank Columbia River by gravity, pumping 80 feet	6,000
Along left bank Columbia River by gravity, pumping 200 feet	9,000
Along left bank Columbia River by gravity, pumping 225 feet	16,000
Along left bank Columbia River by gravity, pumping 290 feet	26,000
Along left bank Columbia River near Pasco	25,000
Total	129,000

The lands near Pasco would be reached by electric transmission line and pumping plant, the average lift to lands being 125 feet. As the development of the projects already approved will leave no funds available for many years for undertaking new projects in Washington, further studies and surveys of secondary projects have been discontinued. Most of the lands withdrawn in connection therewith have since been restored.

The expenditures are summarized in the following table:

Expenditures, according to purpose and nature, on proposed Priest Rapids project to June 30, 1906.

[Total, $6,191.83.]

	Services.	Traveling.	Subsistence.	Equipment.	Supplies.	Rent and storage.	Forage.
Engineering:							
Examination	$2,448.19	$591.90	$556.47	$54.66	$171.53	$30.00	$428.77
Survey	1,156.23	46.05	133.87		29.17		33.25
Design	70.00						
Rights and property		13.00					
Administration	372.48	8.23		20.11	5.42	22.50	

USE OF STATE WATERS FOR IRRIGATION.

The Washington State legislature, on March 1, 1905, passed an act relating to the appropriation of waters of the State for irrigation purposes, etc., granting the United States certain rights of eminent domain and of withdrawal of State lands and waters, and excepting water-users' associations organized under the Reclamation Act from certain taxes.

The following is a copy of the law which became effective March 4, 1905:

AN ACT Relating to the appropriation of waters of the State for irrigation purposes, granting to the United States the right to exercise the power of eminent domain in acquiring lands, water, and other property for rights of way, and for reservoirs and other irrigation works, granting to the United States certain rights in State lands and in the waters of the State, relating to water-users' associations, and declaring an emergency.

Be it enacted by the legislature of the State of Washington:

SECTION 1. The United States is hereby granted the right to exercise the power of eminent domain to acquire the right to the use of any water, to acquire or extinguish any rights, and to acquire any land or other property for the construction, operation, repairs to, maintenance, or control of any plant or system of works for the storage, conveyance, or use of water for irrigation purposes, and whether such water, rights, lands, or other property so to be acquired belong to any private party, association, corporation, or to the State of Washington, or any municipality thereof; and such power of eminent domain shall be exercised under and by the same procedure as now is or may be hereafter provided by the law of this State for the exercise of the right of eminent domain by ordinary railroad corporations, except that the United States may exercise such right in the proper court of the United States as well as the proper State court.

SEC. 2. The United States shall have the right to turn into any natural or artificial water course any water that it may have acquired the right to store, divert, or store and divert, and may again divert and reclaim said waters from said water course for irrigation purposes subject to existing rights.

SEC. 3. Whenever the Secretary of the Interior of the United States, or any officer of the United States duly authorized, shall notify the commissioner of public lands of this State that, pursuant to the provisions of the act of Congress approved June 17, 1902, entitled "An act appropriating the receipts from the sale and disposal of public lands in certain States and Territories to the construction of irrigation works for the reclamation of arid lands," or any amendment of said act or substitute therefor, the United States intends to make examinations or surveys for the utilization of certain specified waters, the waters so described shall not thereafter be subject to appropriation under any law of this State for a period of one year from and after the date of the receipt of such notice by such commissioner of public lands; but such notice shall not in anywise affect the appropriation of any water theretofore in good faith initiated under any law of this State, but such appropriation may be completed in accordance with the law in the same manner and to the same extent as though such notice had not been given. No adverse claim to any of such waters initiated subsequent to the receipt by the commissioner of public lands of such notice shall be recognized under the laws of this State, except as to such amount of the waters described in such notice or certificate hereinafter provided as may be formally released in writing by a duly authorized officer of the United States. If the said Secretary of the Interior, or other duly authorized officer of the United States, shall, before the expiration of the said period of one year, certify in writing to the said commissioner of public lands that the project contemplated in such notice appears to be feasible and that the investigation will be made in detail, the waters specified in such notice shall not be subject to appropriation under any law of this State for the further period of three years following the date of receipt of such certificate, and such further time as the commissioner of public lands may grant, upon application of the United States or some one of its authorized officers, and notice thereof first published once in each week for four consecutive weeks in a newspaper published in the county where the works for the utilization of such waters are to be constructed, and if such works are to be in or extend into two or more counties, then for the same period in a newspaper in each of such counties: *Provided*, That in case such certificate shall not be filed with said commissioner of public lands within the period of one year herein limited therefor the waters specified in such notice shall, after the expiration of said period of one year, become unaffected by such notice and subject to appropriation as they would have been had such notice never been given: *And further provided*, That in case such certificate be filed within said one year and the United States does not authorize the construction of works for the utilization of such waters within said three years after the filing of said certificate, then the waters specified in such notice and certificate shall, after the expiration of said last-named period of three years, become unaffected by such notice or certificate and subject to appropriation as they would have been had such notice never been given and such certificate never filed.

SEC. 4. Whenever said Secretary of the Interior, or other duly authorized officer of the United States, shall cause to be let a contract for the construction of any irrigation works, or any works for the storage of water for use in irrigation, or any portion or section thereof, for which the withdrawal has been effected as provided in section 3 of this act, any authorized officer of the United States, either in the name of the United States or in such name as may be determined by the Secretary of the Interior, may appropriate, in behalf of the United States, so much of the unappropriated waters of the State as may be required for the project, such appropriation to be made, maintained, and perfected in the same manner and to the same extent as though such appropriation had been made by a private person, corporation, or association, except as to the time for the initiation, prosecution, and completion of the necessary works for the utilization of the water so appropriated; which time shall be controlled by the provisions of section 3 of this act. Such appropriation by or on behalf of the United States shall inure to the United States and its successors in interest in the same manner and to the same extent as though said appropriation had been made by a private person, corporation, or association. The title to the beds and shores of any navigable lake or stream utilized by the construction of any reservoir or other irrigation works created or constructed as a part of such appropriation hereinbefore in this section provided for shall vest in the United States to the extent necessary for the maintenance, operation, and control of such reservoir or other irrigation works.

SEC. 5. When the notice provided for in section 3 of this act shall be given to the commissioner of public lands the proper officers of the United States may file with the said commissioner a list of lands (including in the term "lands" as here used the beds and shores of any lake, river, streams, or other waters) owned by the State, over or upon which the United States may require rights of way for canals, ditches, or laterals or sites for reservoirs and structures therefor or appurtenant thereto, or such additional rights of way and quantity of land as may be required for the operation and maintenance of the completed work for the irrigation project contemplated in such notice, and the filing of such list shall constitute a reservation from the sale or other disposal by the State of such lands so described; which reservation shall, upon the completion of such work and upon the United States by its proper officers filing with the commissioner of public lands of the State a description of such lands by metes and bounds or other definite description, ripen into a grant from the State to the United States. The State, in the disposal of lands granted from the United States to the State, shall reserve for the United States rights of way for ditches, canals, laterals, telephone and transmission lines which may be required by the United States for the construction, operation, and maintenance of irrigation works.

SEC. 6. After the receipt by the commissioner of public lands of the notice from the Secretary of the Interior, or other officer of the United States provided for in section 3 of this act, no lands belonging to the State susceptible of irrigation and within the area to be irrigated from the work projected by the United States and specified in such notice shall be sold except in conformity to the classification of farm units by the United States, and the title to such lands shall not pass from the State until the applicant therefor shall have fully complied with the provisions of the law of the United States and the regulations thereunder concerning the acquisition of the right to use water from such works, and shall produce the evidence thereof duly issued: Provided, That the restrictions upon the sale or other disposal by the State of any State lands provided for in this section shall continue for the same period, respectively, and upon the same conditions as specified in section 3 of this act for the withdrawal of waters from appropriation: And provided further, That in case the authorization by the United States for the construction of irrigation works pursuant to section 3 of this act shall be made within the period of three years specified therefor in said section, then the restrictions upon and conditions described for the sale or other disposal of said lands in this section shall continue so long as any such lands shall remain unsold or not disposed of.

SEC. 7. That any water users' association which is organized in conformity with the requirements of the United States under said act of Congress, and which under its articles of incorporation is authorized to furnish water only to its stockholders, shall be exempt from the payment of any incorporation tax and from the payment of any annual franchise tax, but shall be required to pay, as preliminary to its incorporation, only a fee of twenty dollars for the filing and recording of its articles of incorporation and the issuance of certificate of incorporation.

SEC. 8. It shall be the duty of the county auditor to provide record books containing printed forms of the articles of incorporation and stock subscriptions to the stock of water users' associations organized in conformity to the requirements of the United States under said act of Congress, and to use such books for recording stock subscriptions of such associations; and the charges for the recording thereof shall be made on the papers of the number of words actually written therein and not for the printed form.

SEC. 9. An emergency exists, and this act shall take effect immediately.

Passed the house February 28, 1905.

JOSEPH G. MEGLER,
Speaker of the House of Representatives.

Passed the senate March 1, 1905.

CHARLES E. COON,
President of the Senate.

Approved March 4, 1905.

ALBERT E. MEAD,
Governor.

Filed in the office of the secretary of state, at 11.50 a. m., March 8, 1905.

SAM. H. NICHOLS,
Secretary of State.

WYOMING.

SHOSHONE PROJECT.

GENERAL STATEMENT.

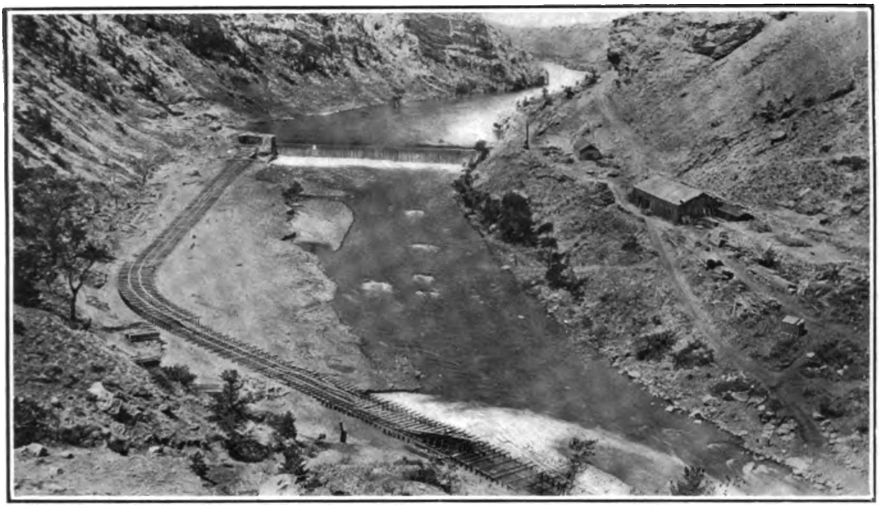
The main features of the Shoshone project are summarized below:

Summary of principal data relating to Shoshone project.

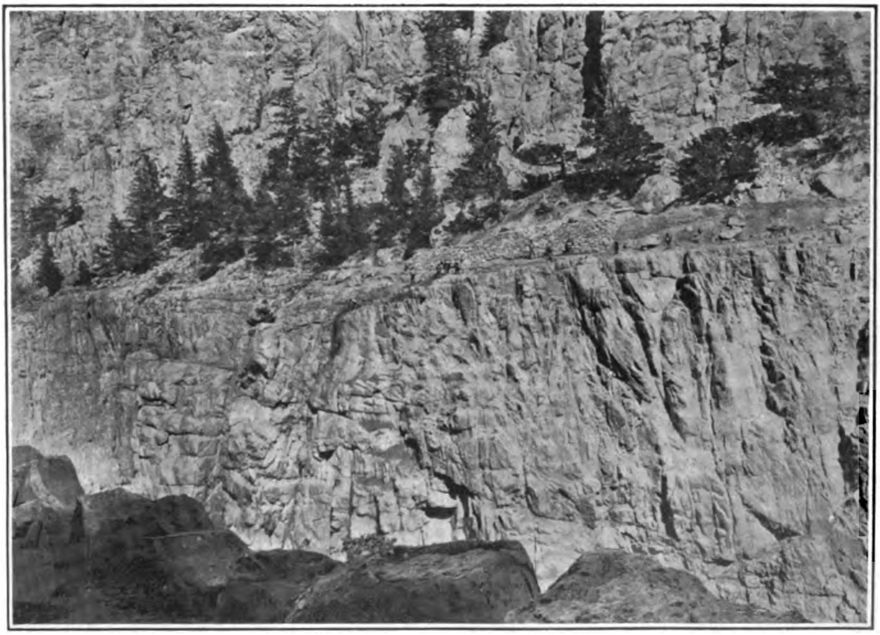
County: Bighorn.
Latitude: 44° 30′.
Longitude: 108°.
Townships: 52–58 north.
Range: 95–102 west.
Irrigable area: 125,000 acres.
Watershed area: 1,380 square miles.
Average rainfall: 6 to 10 inches.
Estimated run-off: 1,027,000 acre-feet at Cody in 1903.
Range of temperature: Maximum, 95°; minimum, 30°.
Average elevation: 4,000 to 5,000 feet.
Principal products: Hay and grain.
Nearest railroad: Chicago, Burlington and Quincy Railroad.
Nearest station: Garland, Wyo.
Principal market: Local.
Area of reservoir: 6,600 acres.
Capacity of reservoir: 456,000 acre-feet.
Duty of water: 1 cubic foot per second for 80 acres.
Height of dam: 310 feet above foundation.
Length of dam: Top, 200 feet; bottom, 85 feet.
Type of dam: Concrete arch.
Length of main canals: 60 miles.
Length of laterals: 150 miles.
Per cent public land: 98.
Character of soil: Light sandy and clay loams.
Value of irrigated land: $25 to $75.

The Shoshone project will provide water for the irrigation of a large area in the vicinity of Cody, Wyo. The water of Shoshone River will be stored in a large reservoir that will be formed by building the Shoshone dam in the gorge of Shoshone River, between Rattlesnake and Cedar mountains. The stored water will be turned into the river as needed, and at the Corbett dam will be diverted through the Corbett tunnel into the Garland canal, the main low-line canal.

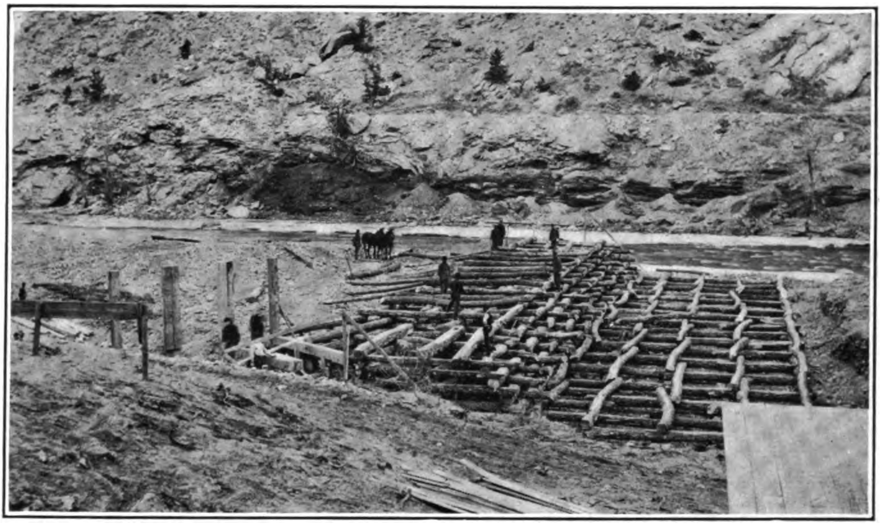
The project office is located in the town of Cody, three rooms and basement being rented. The basement is used as a commissary, from which all supplies are issued to the various field parties. Buildings have been erected at the Corbett tunnel for the accommodation of the engineers employed on that work. At a point on the railroad midway between Garland and Ralston a camp has been established and



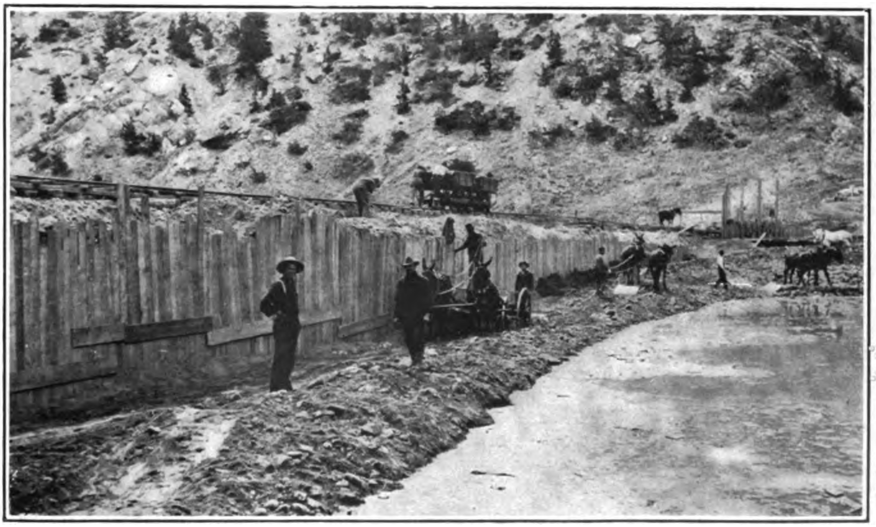
A. TEMPORARY DAM IN SHOSHONE RIVER AND FLUME FOR DIVERTING WATER DURING CONSTRUCTION OF THE SHOSHONE DAM, SHOSHONE PROJECT, WYOMING, MAY 20, 1906.



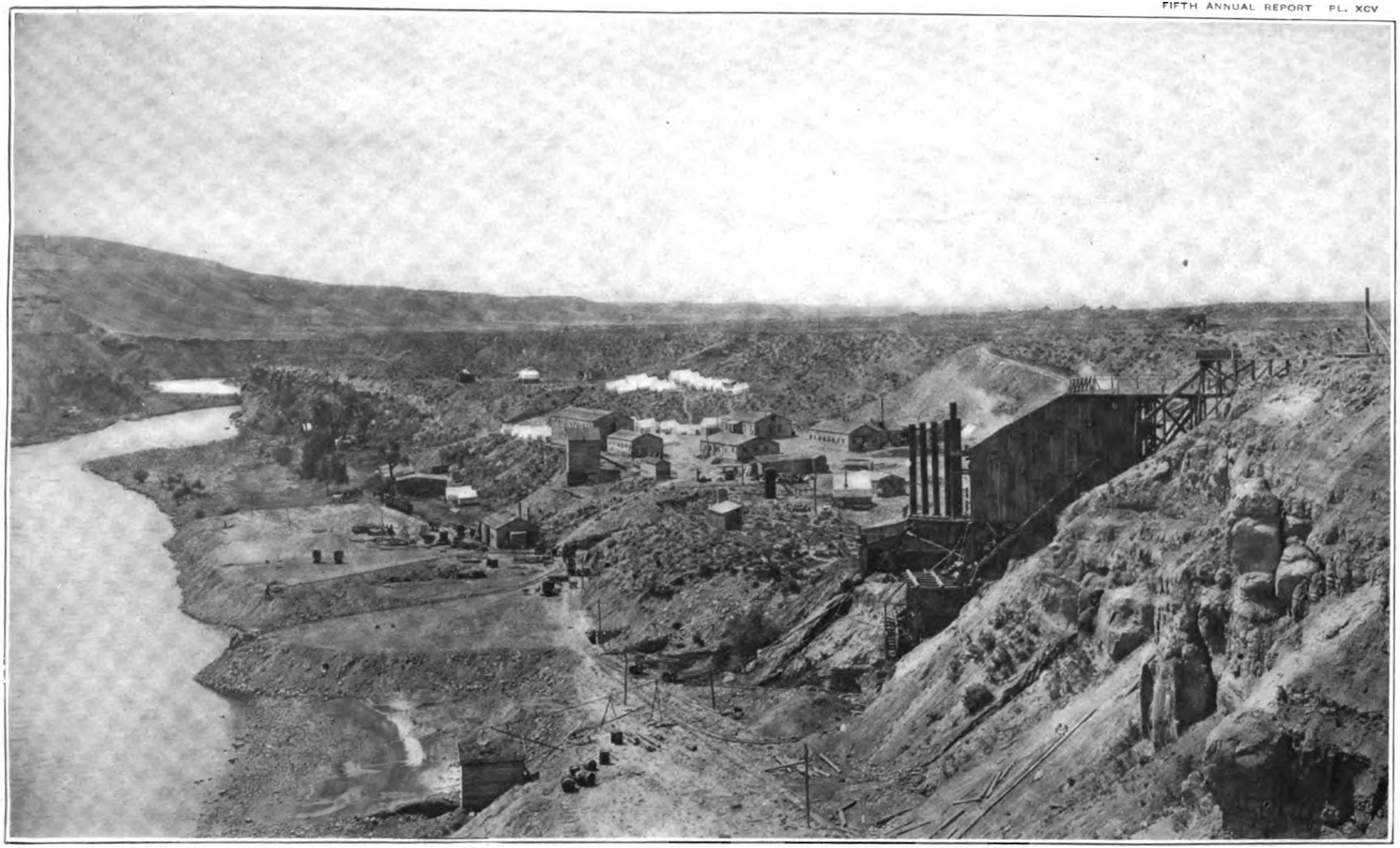
B. TOP OF RIGHT ABUTMENT OF SHOSHONE DAM, ELEVATION 5,390 FEET, SHOSHONE PROJECT, WYOMING, JUNE 12, 1906.



A. CONSTRUCTING TEMPORARY DAM IN SHOSHONE RIVER, SHOSHONE PROJECT, WYOMING, JANUARY 24, 1906.

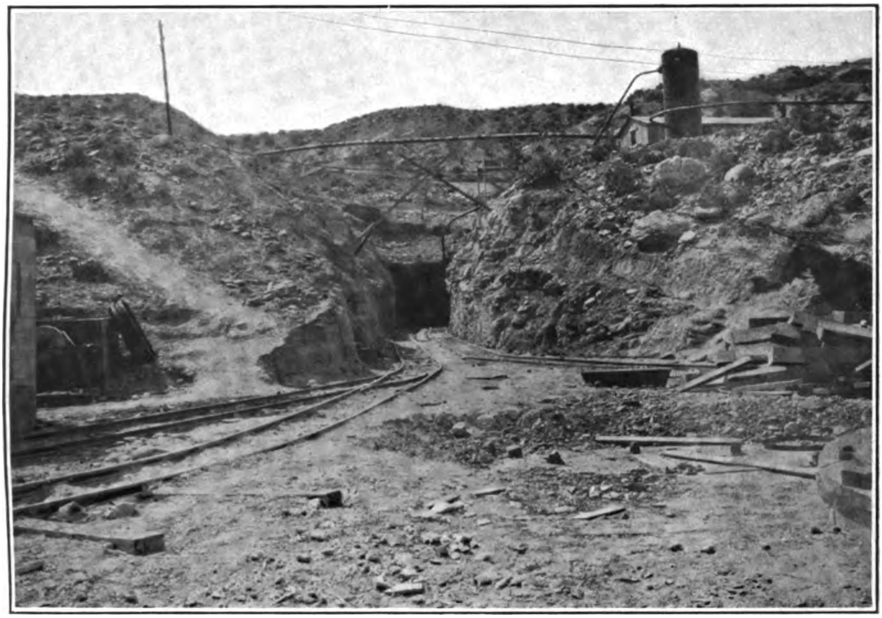


B. UPSTREAM FACE OF TEMPORARY DAM IN SHOSHONE RIVER, SHOSHONE PROJECT, WYOMING, MARCH 31, 1906.

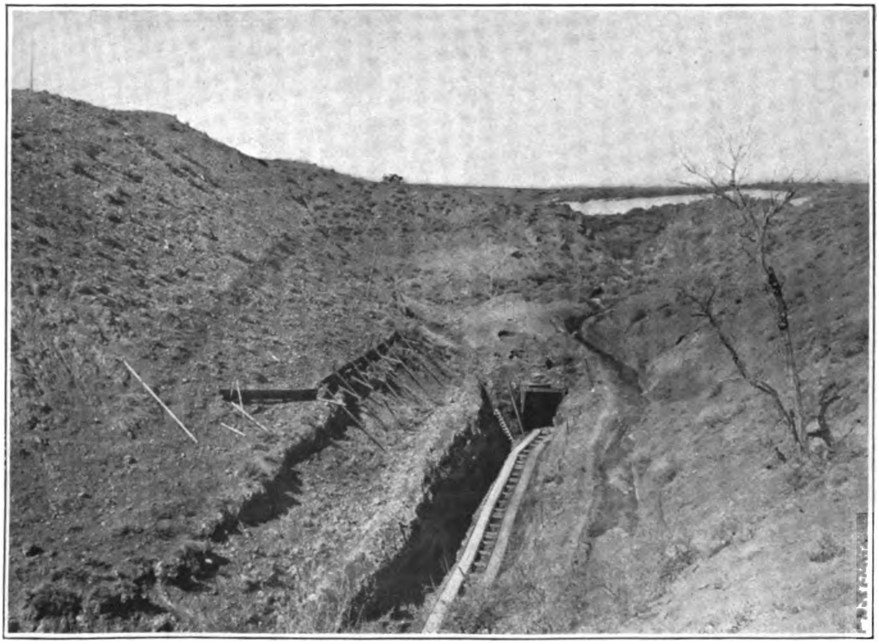


CONTRACTORS' CAMP AT UPPER END OF CORBETT TUNNEL, SHOSHONE PROJECT, WYOMING, MAY 23, 1906.

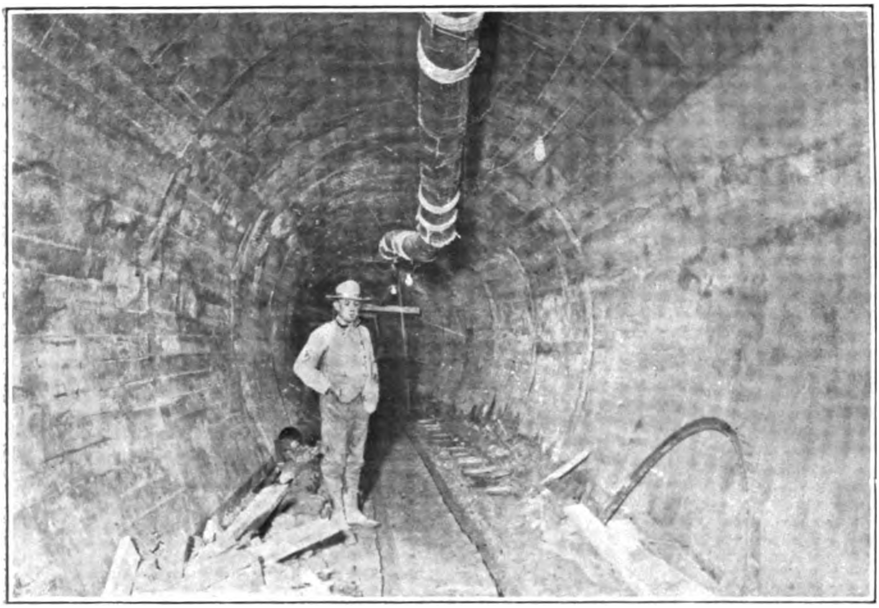
U of M



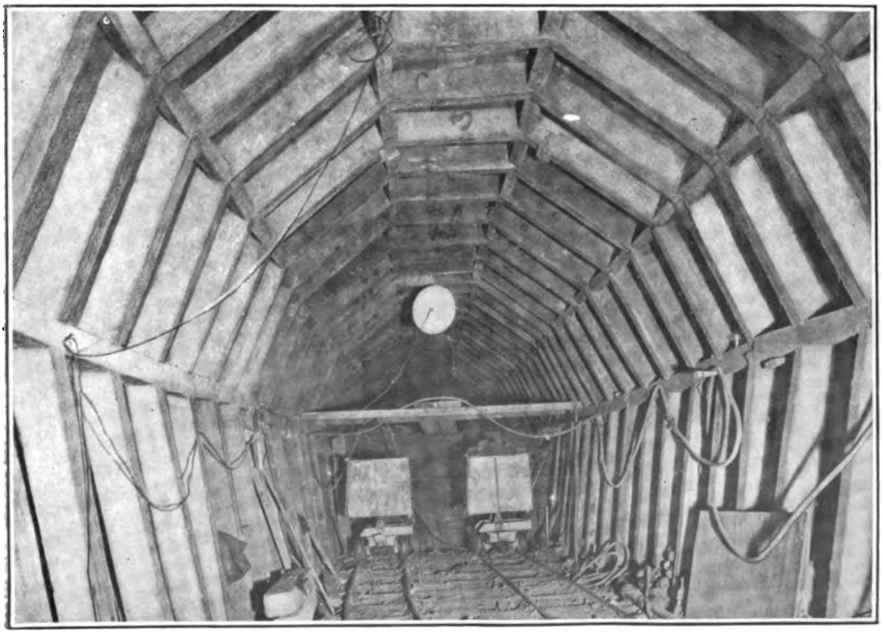
A. PORTAL, ADIT NO. 1, CORBETT TUNNEL, SHOSHONE PROJECT, WYOMING, APRIL 23, 1906.



B. PORTAL, ADIT NO. 3, CORBETT TUNNEL, SHOSHONE PROJECT, WYOMING, APRIL 12, 1906.



A. CONCRETE-LINED PORTION OF CORBETT TUNNEL SHOSHONE PROJECT, WYOMING, COMPLETE EXCEPT FLOOR, JUNE 24, 1906.



B. TIMBER-LINED SECTION OF CORBETT TUNNEL, SHOSHONE PROJECT, WYOMING, ABOUT 3,000 FEET FROM ENTRANCE, APRIL 23, 1906.

buildings erected for the accommodation of the engineers employed on the canals and distributing system. A telephone system has been installed, a road built into the canyon, and a steam and electric-light plant erected.

In the following table are listed the contracts entered into for building work on the Shoshone project. This list includes all contracts for excavation, embankment, masonry, and erection of structures, but does not include materials such as cement, steel, timber, etc.

Contracts for building work on Shoshone project to June 30, 1906.

No. of contract.	Contractor.	Feature.	Estimated total value.	Payments to June 30, 1906.	Per cent paid.
67	Prendergast & Clarkson [a]	Shoshone dam	$515,730.00	$46,250.88	9
68	Charles Spear [b]	Corbett tunnel	594,325.00	66,026.03	11

[a] Contractor in default. Work carried on by surety, U. S. Fidelity and Guaranty Company, under supplemental contract.

[b] Contractor in default. Work carried on by force account.

SHOSHONE DAM.

On September 18, 1905, the contract for building the Shoshone dam was awarded to Prendergast & Clarkson, of Chicago, for $515,730, and on October 20 they arrived on the ground, beginning work shortly afterwards on the temporary diverting works and outlet tunnel. Before high water in June, 1906, the temporary diverting dam and the excavation of the outlet tunnel were completed. About one-half of the outlet tunnel was lined and about 800 feet of flume extending downstream from the diverting dam constructed. The temporary dam (Pls. XCIII and XCIV) is a crib structure filled with earth and rock and covered with planking. Its length is 430 feet and its maximum height is 17 feet. The flume is designed to carry the flow of the river after it dropped to a discharge of 2,000 second-feet, which generally occurs about August 1, remaining below that figure until about May of the following year. During the early morning of June 13 the river reached its maximum discharge for the year, of about 13,000 cubic feet per second. This quantity of water passed over the crest of the temporary dam without doing it any material damage. It, however, practically destroyed all of the flume. In addition to the work above described the contractors have done some excavating on the spillway on the abutments of the dam, and in the roadway tunnel. They have installed a plant of four 80-horsepower boilers, air compressors, and stone crusher, and have constructed a cement storehouse having a capacity of about 12,000 barrels. Their failure to complete the outlet tunnel before high water and their failure to take the necessary steps for assembling material on the ground for the immediate reconstruction of the flume will be a serious setback to the work, and probably delay its completion very materially.

CORBETT TUNNEL.[a]

On September 16, 1905, the contract for excavating the Corbett tunnel (Pls. XCV–XCVII) was awarded to Charles Spear, of Billings,

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[a] See Fourth Ann. Rept. Reclamation Service, Pl. LVIII.

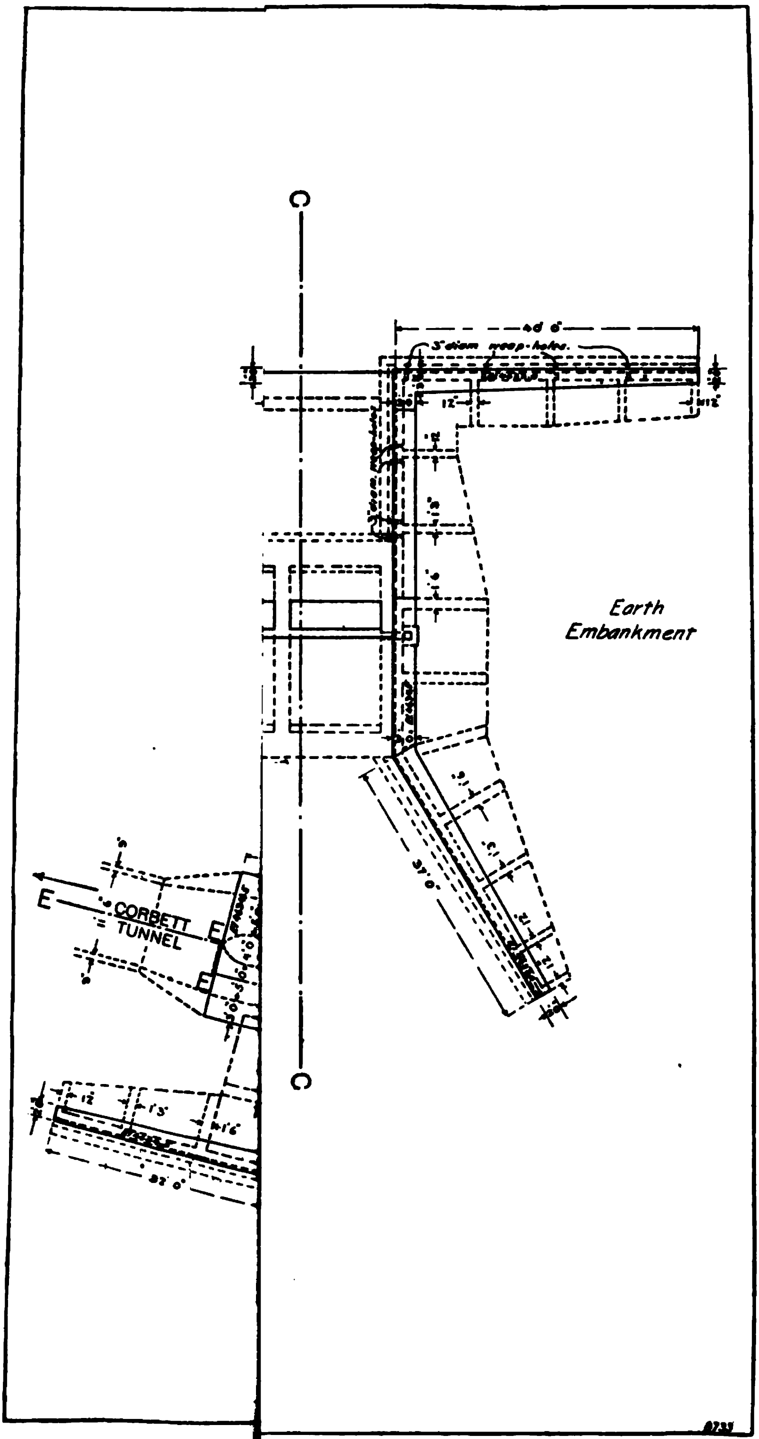
Mont., for $594,325. On November 2 the contractor began constructing quarters for his men (Pl. XCV). The work of excavating the adits began on November 3. Very slow progress was made in this work, the main tunnel line not being reached in adit No. 1 until January 14, 1906, at which date the excavation of the main tunnel began. In March a change in management was made and since that time better progress has been made. The excavation is being carried on from 7 headings, and it is expected that 2 more headings will be opened on the completion of a shaft that is now being excavated. Up to July 1, 1906, a total of 4,500 linear feet of tunnel had been excavated, of which 970 feet are lined, with the exception of the floor of the tunnel. The material being penetrated in the different headings varies from dry clay, through shales of various characters, to a stratified sandstone of different degrees of hardness. On exposure to the air the material disintegrates very rapidly and droppings of rock from the roof occur frequently. Water in small quantities is being encountered in all of the headings, which adds somewhat to the difficulty of excavation. On account of the soft character of the material encountered in many parts of the tunnel, considerable permanent timbering has to be put in. Considerable difficulty is experienced in keeping the labor supply up to the requirements. The excavation of the sluicing tunnel at the settling basin has been completed and about 150 linear feet of completed lining is in place.

CORBETT DAM.

Across Shoshone River, at the head of the Corbett tunnel, there will be built a weir for the purpose of diverting the water into the tunnel. This structure has been designated the Corbett dam. (Pls. XCVII–XCIX.) It will be a reenforced concrete structure containing about 5,000 cubic yards of concrete and about 250,000 pounds of steel reenforcement. It will be 400 feet in length on the crest, and will have a maximum height of about 18 feet. Plans and specifications for this structure were prepared during the year under the direction of a board of engineers.

CANALS.

The main low line canal, heading at the outlet of the Corbett tunnel and covering land in the vicinity of Garland, has been designated the Garland canal (Pl. CI). Plans and specifications for division 1 of this canal were prepared under the direction of a board of engineers and bids were to be opened on May 24, 1906. Only one bid was received, that of the Billings Construction Company, of Billings, Mont., for sections 2, 3, and 8. As this bid was deemed excessive, it was rejected and the work readvertised.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C
40' 6"
3" diam weep-holes.
12"
12"
Earth
Embankment
37' 0"
E
CORBETT
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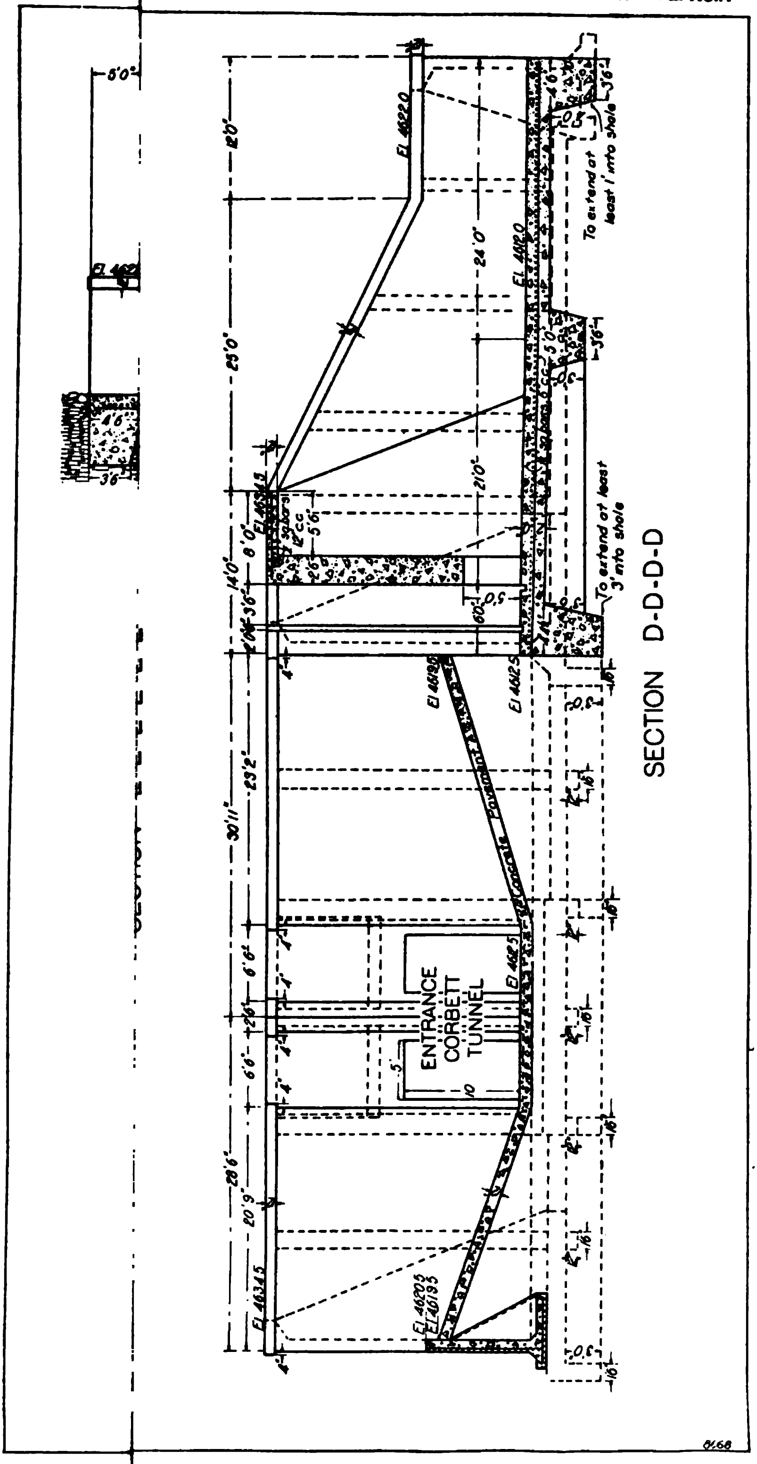
1'3"
1'6"
32' 0"
4'0"
5'0"

OMING.


SECTION D-D-D-D
ENTRANCE CORBETT TUNNEL
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El 4612.0
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El 4619.5
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El 4619.5
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25'0"
14'0"
8'0"
3'6"
30'11"
23'2"
6'6"
2'6"
28'6"
20'9"
24'0"
21'0"
6'0"
5'0"
4'6"
3'6"
1'6"
0'6"
4"
El 462
5'0"
8168

WYOMING.

Elev 4563
LATED STR

Bids opened May 24, 1906, for division 1, Garland canal, Shoshone project.

[Specifications, No. 84.]

SCHEDULE I (SECTION 2, STATION 183 TO STATION 240).

Work or material.	Quantity.	Billings Construction Co., Billings, Mont.	
		Price.	Amount.
Grading:			
Class 1 ... cubic yards	138,000	$0.25	$34,500.00
Class 2 ... do	14,000	.60	8,400.00
Class 3 ... do	62,000	1.25	77,500.00
Overhaul ... do	6,000	.01½	90.00
Rolling embankments ... do	6,000	.01	60.00
Water for puddling ... gallons	250,000	.60	150.00
Concrete ... cubic yards	50	10.00	500.00
Rubble masonry ... do	550	3.50	1,925.00
Riprap ... do	100	3.50	350.00
Gravel foundation ... do	20	1.00	20.00
Laying 30-inch pipe ... linear feet	130	2.00	260.00
Wire fabric ... pounds	260	.10	26.00
Total			123,781.00

SCHEDULE II (SECTION 3, STATION 240 TO STATION 287+97.9).

Work or material.	Quantity.	Price.	Amount.
Grading:			
Class 1 ... cubic yards	117,000	$0.25	$29,250.00
Class 2 ... do	100	.60	60.00
Class 3 ... do	8,000	1.25	10,000.00
Overhaul ... do	176,000	.01½	2,640.00
Rolling embankments ... cubic yards	52,000	.01	520.00
Water for puddling ... 1,000 gallons	2,400,000	.60	1,440.60
Concrete ... cubic yards	710	10.00	7,100.90
Riprap ... do	40	3.50	140.00
Gravel foundation ... do	200	1.00	200.00
Laying 12-inch pipe ... linear feet	100	1.00	100.00
Wire fabric ... pounds	320	.10	32.00
Steel for reenforcement ... do	16,610	.06	996.60
Total			52,478.60

SCHEDULE VI (SECTION 8, STATION 500 TO STATION 586).

Work or material.	Quantity.	Price.	Amount.
Grading:			
Class 1 ... cubic yards	85,000	$0.25	$21,250.00
Class 2 ... do	100	.60	60.00
Class 3 ... do	100	1.25	125.00
Overhaul ... do	33,000	.01½	495.00
Rolling embankments ... do	20,000	.01	200.00
Water for puddling ... 1,000 gallons	1,000,000	.60	600.00
Concrete ... cubic yards	155	10.00	1,550.00
Riprap ... do	1,200	3.50	4,200.00
Gravel foundation ... do	60	1.00	60.00
Steel for reenforcement ... pounds	5,800	.06	348.00
Placing structural steel, gates, and fittings ... do	18,000	.03	540.00
Lumber ... feet B. M.	500	40.00	20.00
Wire fabric ... pounds	40	.10	4.00
Total			29,452.00

Plans and specifications are being prepared for the remaining portion of the Garland canal and for the distributing system for 40,000 acres in the vicinity of Garland. It is expected that bids for this work will shortly be advertised for.

SOIL SURVEY.

The soil survey of 50,000 acres has been completed. The area is now being subdivided into farm units of 80 acres each.

CEMENT.

Bids for 25,000 barrels of cement were opened at Billings, Mont., on September 26, 1905. Three bids were received, the lowest ($1.30

per barrel at Chicago) being that of the Illinois Steel Company. In view of the prices previously paid for cement, the lowest price bid was considered high. Therefore all bids were rejected, and authority obtained to purchase 5,000 barrels of cement in open market, without advertisement, at a price not to exceed $1.30 per barrel f. o. b. cars, Chicago. The 5,000 barrels were accordingly purchased in open market at $1.25 per barrel f. o. b. cars, Chicago. Subsequently authority was obtained for the purchase of 13,000 barrels in open market. This quantity was purchased at $1.25 per barrel for deliveries before May 1, 1906, and $1.30 for deliveries during May and June.

LUMBER.

All lumber used in the Corbett tunnel during the year has been purchased in the open market. Some delay in carrying on the work on the Corbett tunnel was caused by the difficulty in obtaining prompt delivery of the lumber after being loaded on the cars at the mills, many cars being six weeks in transit between Portland, Oreg., and Corbett. Owing to the delay in obtaining lumber from Pacific coast points, it was decided to look elsewhere for it. An investigation accordingly was made of the timber conditions on Pryor Mountain, in Montana. This investigation has shown that there is sufficient timber on this mountain to supply the requirement for timbering the Corbett tunnel. The delivery of this timber at the Corbett tunnel involves a wagon haul of 14 miles over a good wagon road and a railroad haul of only 77 miles. On July 27, 1906, the Secretary of the Interior granted permission for the cutting of timber for use on Shoshone and other projects from unsurveyed public lands in Pryor Mountains. It is proposed to enter into a contract with a local sawmill for the cutting, sawing, and delivery of the lumber at the railroad.

LAND PURCHASES.

Payments for lands covered by the Shoshone reservoir are being made. During the year payments for about 2,000 acres were made. Some delay in acquiring the lands has been caused by various defects in titles.

IRRIGABLE LANDS.

The approximate distribution of the irrigable lands is shown by the following table:

Lands included in Shoshone project.

	Acres.	Percentages.
GENERAL.		
Total	151,680	
Private	1,420	01−
Public	150,260	99+
Irrigable	132,000	87+
Nonirrigable	19,680	13−
PRIVATE.		
Total	1,420	
Irrigable	1,220	86−
Nonirrigable	200	14+
PUBLIC.		
Total	150,260	
Irrigable	130,780	87+
Nonirrigable	19,480	13−
IRRIGABLE.		
Total (all in Big Horn County)	132,000	
North of Shoshone River	107,000	81+
South of Shoshone River	25,000	19−
Bottom land, Shoshone River	None.	
Under existing canals[a]	1,900	00+
Above existing canals	130,100	100−
Public	130,780	99+
Private	1,220	01−
NONIRRIGABLE.		
Total	19,680	
Public	19,480	99−
Private	200	01+

[a] Under Elk Canal title to lands still in the United States.

EXPENDITURES.

The expenditures on the Shoshone project are summarized in the following tables:

Expenditures, according to physical features, on Shoshone project to June 30, 1906.

Features.	Engineering and administration.	Building.
Incidental structures:		
Shoshone Canyon road, 4 miles	$3,800.00	$44,163.07
Telephone line, 15 miles	100.00	1,122.00
Shoshone dam, temporary works	1,750.00	29,106.04
Headquarters—		
Offices	831.00	2,710.00
Lodging and boarding houses	3,125.00	10,059.02
Warehouses, corrals, etc	50.00	1,000.00
Irrigation structures:		
Shoshone reservoir, lands submerged	3,700.00	42,032.07
Shoshone dam and spillway	20,421.00	8,763.01
Shoshone outlet works and gates	2,290.00	13,145.02
High-line canal	18,520.00	
Corbett diversion weir	1,006.00	
Tunnel headworks, sluiceway, and gates	316.00	
Corbett tunnel	18,314.00	73,012.11
Corbett-Garland-Frannie canal	27,230.00	
Willwood diversion weir	225.00	
Tunnel, headworks, sluiceway, and gates	130.00	
Willwood tunnel	630.00	
Willwood canal	6,816.00	
Distributing system	1,272.00	
Irrigable lands:		
Farm unit subdivision and soil examination	479.00	
Examination of project as a whole	1,478.19	
Administration of project as a whole	9,718.80	
Total	122,201.99	225,112.34
Grand total		347,314.33

Expenditures, according to purpose and nature, on Shoshone project to June 30, 1906.

[Total, $347,314.33.]

	Services.	Traveling.	Subsistence.	Equipment.	Materials.	Supplies.	Rent and storage.	Forage.	Job work.
Engineering:									
Examination	$426.68	$214.24	$19.91	$316.81		$487.05		$13.38	
Survey	47,999.11	6,203.88	7,703.07	10,660.68	$45.75	7,670.72		3,213.79	
Design	10,421.46	791.41	822.62	280.27	5.60	204.84	$19.11	76.99	
Subdivision	237.31	149.61	84.42		1.32			6.15	
Building:									
Rights and property	269.75	95.65	31.50			134.01	1.00		
Building	49,716.59	1,073.99	6,276.97	2,104.58	14,227.99	59,247.27	146.85	2,417.09	$89,369.10
Administration	17,415.23	1,332.61	959.82	1,335.21		2,556.74	216.45	309.75	

PROPOSED LAKE DE SMET PROJECT.

This proposed project was examined by Capt. H. M. Chittenden in 1897, his report being published as House Document No. 141, Fifty-fifth Congress, second session. In 1902, a detailed examination of the project was made by the Reclamation Service, the results of this examination being published in the Second Annual Report. In May, 1906, the project was examined on the ground by a board of engineers, all available data of previous examinations and pertinent records of the office of the water superintendent being given due consideration in connection with this examination of the project.

Lake De Smet is formed by a natural basin in the comparatively low, rolling country east of the Bighorn Mountains. The lake is 8 miles east of the base of the mountains and 2 miles south of Piney Creek. It is 3 miles in length with an average width of a little more than three-fourths of a mile, contains 1,503 acres, and the surface of the water is at an elevation of 4,530 feet above sea level. The lowest point of the rim of its basin is 30 feet above the present surface of the water, so that a natural reservoir site is formed by the basin of the lake. The area of the drainage basin of the lake is 36 square miles, the largest stream flowing into it being Shell Creek, a small stream draining the country immediately west of the lake, the principal source of its water supply being seepage water from irrigation ditches. The lake has no visible outlet.

At the head of Box Elder Creek, 2 or 3 miles southeast of the lake are a number of small lakes, some above and some below the elevation of the water in Lake De Smet. These lakes are fed by springs, and it has been suggested that the water of these springs may come from Lake De Smet. Small basins, some of which contain water, are typical of this region, Lake De Smet itself differing from the others only in its greater size. Owing to the character of the topography of the region it seems hardly probable that the springs referred to are fed by water from Lake De Smet.

The most feasible way of utilizing Lake De Smet for irrigation purposes is to use it as a regulator of Piney Creek. This could be done by diverting the water of this creek into the lake by means of a canal 4 miles in length, and returning it to the creek through an outlet at the north end of the lake. Measurements of the discharge of Piney Creek were made in 1903, 1904, and 1905. The storage capacity of Lake De Smet between the present water surface and the lowest point of the rim—a vertical distance of 30 feet—is 55,000 acre-feet, which is enough to regulate the entire flow of Piney Creek.

Stored water discharged through an outlet at the north end of Lake De Smet could be utilized on lands along Piney Creek and along Clear Creek below the mouth of Piney. Water from the south end of the lake could be used on lands along Clear Creek and Box Elder Creek. However, an outlet at the south end is not considered feasible owing to its high cost. The lands along Clear Creek can be better served from Clear Creek than from Lake De Smet. There is so little land along Box Elder Creek that it is hardly worth considering. Moreover, it can be more cheaply irrigated from the ditch now constructed from Rock Creek to the Box Elder Creek drainage. It has been suggested that water from Lake De Smet be used on lands along Prairie Dog Creek northeast of Sheridan. With this end in view a reconnaissance from a point on Piney Creek north of Lake De Smet to the Divide between Piney and Prairie Dog creeks was made. This reconnaissance indicates that it is feasible to convey water from Lake De Smet to Dutch Creek, a tributary of Prairie Dog Creek, through a canal about 20 miles in length and through a tunnel about one-half mile long. However, in order to determine this matter more definitely, a topographic survey of the divide between Piney and Prairie Dog creeks should be made.

An examination of records of water rights in the office of the water superintendent shows the following adjudicated rights on Piney Creek and tributaries.

Water rights on Piney Creek.

ADJUDICATED RIGHTS.

	Acres.
Above proposed Lake De Smet outlet	19,250
Below proposed Lake De Smet outlet	4,053
Piney Creek and tributaries	7,882
On Prairie Dog Creek	15,421
On Clear Creek below mouth of Piney	3,357
Total	49,963

UNADJUDICATED RIGHTS.

Above proposed Lake De Smet outlet	848
Below proposed Lake De Smet outlet	1,198
Piney Creek and tributaries	1,648
On Prairie Dog Creek	398
On Clear Creek below mouth of Piney	2,762
Total	6,854

There are thus both adjudicated and unadjudicated rights for 56,817 acres. These filings are based on a duty of 70 acres per second-foot of water. Allowing 1½ acre-feet of water for each acre irrigated—which is probably somewhat more than the quantity used—the irrigation of this quantity of land would require 85,225 acre-feet to which would be added 3,651 acre-feet of storage rights, making a total of 88,876 acre-feet, which is considerably more than the annual discharge of the stream. It therefore would seem that there is no unappropriated water left for the reclamation of additional land, but that the best that could be expected would be the regulation of the stream so that the present appropriators may have water in proper quantities when needed.

A feasible way of utilizing the stored water is to discharge it back into Piney Creek from the north end of the lake and utilize it on lands along Piney or Clear creeks that now have water rights but an insufficient water supply.

The present water supply for lands along Prairie Dog Creek could be increased by diverting additional water from the unregulated flow of Piney Creek and delivering it through canals now in operation, from Piney to Prairie Dog Creek in the vicinity of Banner, and replacing the water thus transferred by stored water from Lake De Smet.

If future surveys show that it be feasible to convey water from Lake De Smet to the head of Dutch Creek west of Ulm, lands along this creek now having an insufficient water supply could be supplied from this source.

As practically all of the irrigable land tributary to Lake De Smet is in private ownership, and as the water of Piney Creek has been appropriated by a large number of small landowners, it was thought desirable to give the private owners of the land an opportunity to increase their present water supply; therefore the area withdrawn for investigation by the Reclamation Service was restored to entry by Secretary's order dated June 9, 1906.

Expenditures, according to purpose and nature, on proposed De Smet project to June 30, 1906.

[Total, $8,985.60.]

	Services.	Traveling.	Subsistence.	Equipment.	Supplies.	Rent and storage.	Forage.
Engineering:							
Examination	$4,157.48	$1,048.15	$735.41	$418.12	$392.71	....	$113.03
Survey	1,108.66	339.92	....	....	....	....	....
Design	....	18.50	....	....	....	....	....
Rights and property	....	16.85	....	....	....	....	....
Administration	277.16	128.62	81.76	46.45	46.14	$40.00	16.72

INDEX.

Page.

A.

Accounting, methods of 58
Advertising, discussion of 57-58
Allotments, amount of 43-45
Ankeny canal, Oreg., view of 256
Antelope basin, Mont., surveys in 159-160
Arizona, operations in 85-93, 100-105
Arizona canal, Salt River project, headworks of 90
  purchase of 89-90
Artesian wells, unit prices for 83
Avalon dam, Carlsbad project, description of 210-211
  views and plans of 210

B.

Back filling, bids on 202
Bates & Rogers Construction Company, contract with 117
Bear Lake project (proposed), Utah, expenditures on 48, 274
  status of 273
Beaverhead River, Mont., reservoir site on. 169
Belle Fourche project, S. Dak., allotment for. 43, 45
  bridges for, bids on 268
  canals on 267-268
  cement for, bids on 268
  contracts for work on 266
  diversion dam and headworks of, description and views of 26
  expenditures on 48, 270
  inlet canal of, views on 266
  lands included in 269
  property purchased for 36
  reservoir and dam on 267
  summary of data relating to 265
  town sites on 270
  unit prices for work on 61-84
  work on 265-270
Belle Fourche Water Users' Association, organization of 269-270
Bent, A. S., contract with 111
Benton project (proposed), Wash., expenditures on 48, 291
  status of 291
  See also Yakima district projects.
Bighole River, Mont., reservoir site on 169
Bighorn Canyon, Mont., surveys in 173
Bismarck project (proposed), N. Dak., expenditures on 48, 233
  status of 233

Page.

Black River canal, Carlsbad project, work on 210
Blacktail Deer Creek, Mont., reservoir site on 169
Boise dam, Payette-Boise project, bids on.. 124
Boise River, Idaho, dam in, plans for 124
  discharge diagram of, showing decree concerning water rights 134
  fish ladder in, plans for 124
Bolts, unit prices for 63, 127, 239, 240
Bridges, unit prices for 61, 147, 260, 268
Buford, N. Dak., gage heights of Missouri River at, diagram showing 228
Buford-Trenton project, N. Dak., allotment for 43, 44, 45
  description of 229
  expenditures on 48, 230
  map of 230
  pumping stations for, plans for 230
  See also Williston district projects.
Buildings, unit prices for 61
Bumping Lake reservoir, Wash., capacity of 282
Burke Construction Company, contract with 178

C.

California, lakes in, act authorizing change of level of 20
  operations in 94-105, 255-264
Callahan Brothers, Phelan & Shirley, contract with 236
Callahan, Katz, Phelan & Shirley, contract with 145
Campbell-Ferrier Company, contract with. 240
Canal, concrete lined, view of 108
Canton Bridge Company, contract with 268
Carlsbad project, N. Mex., allotment for 43, 45
  canals on 210-211
  dam for 210-211
  expenditures on 48, 213-214
  lands included in 212-213
  map of 210
  summary of data relating to 209
  work on 209-214
  See also Avalon dam.
Carson River, Nev., improvement of channel of 200
Carson River basin, Nev., description of...
Cascade Canal Company, litigation with 32, 281-282

Page
Cast iron, unit prices for 62, 202, 239
Cazier, T. F., contract with 215, 217
Cement, bids on 111, 131, 149, 250, 261, 268, 278, 299
  contract prices for 84
Cement mill for Salt River project, operation of 88–89
Chapman Valve Manufacturing Company, contract with 242
Cherry Creek basin, Mont., reservoir site in 170
Clarke Fork project (proposed), Mont., expenditures on 48, 167
  map of 166
  work on 164–167
Clealum Lake reservoir, Wash., capacity of 282
Clearing, bids on 277
Cold Springs dam, Umatilla project, bids on 249–250
  plans of 250
Colorado, operations in 106–115
Colorado River, Indian lands along, act for disposition of 21
Colorado River storage, work and expenditures on 48, 114
Conconully reservoir, Okanogan project, map of 276
Concrete, unit prices for 62–63, 124, 127, 129, 130, 144, 146, 147, 202, 239, 240, 248, 249, 250, 257, 258, 259, 260, 277, 299
Concrete flume, Interstate canal, view of 178
  Pecos River, view of 212
Concrete-lined canals, views of 110, 178
Concrete masonry, unit prices for 63, 124
Concrete pressure pipe, forms for, views of 86
Contractors, defaulting, decisions regarding 28
Contracts, discussion of 57
Conway & Wilhite, contract with 123, 126, 128
Corbett dam, Shoshone project, description and plans 298
Corbett tunnel, Shoshone project, headwork of, plans of 298
  views on 296
  work on 297–298
Cost keeping, discussion of 58–60
Cotton Bros. & Co., contract with 144
Cottonwood pressure pipe, Salt River project, view of 86
Crow Indian Reservation, act for disposition of lands in 21–22
Crow Reservation project (proposed), Mont., expenditures on 48, 174
  work on 172–174
Crumb, W. H., contracts with 117, 266
Culvert on Huntley project, views of 144

D.

De Laney, H. C., contract with 237
De Smet Lake project (proposed), Wyo., expenditures on 48, 303
  investigation of 301–303
Deadwood Construction Company, contracts with 176, 178, 235, 238
Deer Flat embankments, Payette-Boise project, bids received for and work on 129–130
  plans of 130
Denver, Northwestern and Pacific Railway Company, litigation with 30
Deschutes River, Oreg., proposed power development on 252
Desert-land entries, legislation on 19
Ditches, bids on 146
D'Olier Engineering Company, contract with 138
Drift bolts, unit prices for 63, 124
Drop on south canal, Uncompahgre Valley project, view of 110
Dubois project (proposed), Idaho, expenditures on 48, 136
  status of 136
Dunbar, H. E., and Elliott, J. B., contract with 111

E.

Earth placing, unit prices for 64
Earth and gravel fill, bids on 129
Electrical power plant, unit prices for 64
Elliott, J. B., & Dunbar, H. E., contract with 111
Embankment, bids on 129–130
Entries and selections, decisions regarding 24–25
Ewauna Lake, Oreg., view of 256
Excavation, unit prices for 64–74, 124, 127, 128, 129, 130, 144, 145, 146, 147, 179, 202, 217, 236, 237, 238, 239, 240, 248, 249, 257, 258, 259, 260, 277
Expenditures, analysis of 51
  discussion of 45–49
  growth of, diagram showing 50

F.

Farm units, legislation on 18
Fill. *See* Rock fill; Earth and gravel fill.
Finances, discussion of 39–58
Fiscal authorization, discussion of 51–53
Fish ladder in Boise River, plans for 124
Flume, Interstate canal, North Platte project, view of 178
  Pecos River, Carlsbad project, view of 212
Force account work, decision regarding 26
Forest reserves, use of material from, legislation on 20
Fort Custer, Mont., surveys near 173
Fort Shaw Military Reservation, act for disposition of lands in 23–24, 157
Freeman, D. H., & Co., contract with 235, 236, 237

G.

Garden City project, Kansas, allotments for 43, 44–45
  expenditures on 48, 140, 141
  lands included in 140
  power plant for, bids on 138–139
  rights of way for 139
  summary of data relating to 137
  test wells on 139
  unit prices for work on 64–64
Garland canal, Shoshone project, bids on 299
  headworks of, plan of 298
Gas-engine plant, bids on 139
Gates, unit prices for 74–75, 101, 242, 278
Gates and guides, unit prices for 74, 125, 126, 148, 257, 258
  setting, bids on 147

Page.

- Gate valves, bids on 239
- Geddis & Seerie Stone Company, contract with 176, 177
- Gish, C. C., injunction against 29
- Grading, bids on 299
- Grand Valley project (proposed), Colorado, expenditures on 48, 114
  - status of 114
- Granite Reef dam, Salt River project, description of and plans for 90
- Gravel filling, bids on 239
- Gravel foundation, unit prices for 75, 299
- Green, R. E., litigation with 30, 135
- Griffiths & McDermott, contracts with 144, 145, 176
- Grubbing, bids on 277
- Guides. *See* Gates and guides.
- Gunnison tunnel, Uncompahgre Valley project, profile of 108
  - work on 107-110

H.

- Hess, E. A., contracts with 107, 235, 240
- Hondo project, New Mexico, allotments for 43, 44, 45
  - canals on 215-217
  - contracts for work on 215
  - irrigated land on 48, 217-218
  - litigation concerning 31
  - outlet and distributing canals for 216-217
  - map of 214
  - property purchased for 35
  - reservoir on 215-216
  - summary of data relating to 214
  - telephone system on 217
  - unit prices for work on 62-84
  - views on 216
  - work on 214-218
- Hubbard & Carlson, contracts with 117, 118, 123, 130
- Hughes, Nick, contract with 144
- Hughes & Olson, contracts with 144
- Huntley project, Mont., allotment for 43, 45
  - canal for, bids received for and work on 143-145
  - cement for 149
  - distribution system for, bids on 146-148
  - expenditures on 48, 150
  - lands included in 149-150
  - summary of data relating to 142
  - telephone system for, bids on 148-149
  - views on 144
  - work on 142-150

I.

- Idaho, operations in 116-136
- Illinois Steel Company, contracts with 131, 149, 240
- Imperial Valley, Cal., conditions in 103-104
- Indian allotments, legislation affecting 20
- Indian lands along Colorado River, act for disposition of 21
- Indian lands. *See also* Pyramid Lake Indian Reservation, Crow Indian Reservation, Yakima Indian Reservation.
- International Bridge Company, contract with 256

Page.

- Interstate canal, North Platte project, cross sections and views of 178
  - diversion dam at head of, plans of 180
  - work on 178
- Iron, cast. *See* Cast iron.
- Irrigation Land and Improvement Company, litigation with 30

J.

- Jackson Lake reservoir, Idaho, work on 119
- Jefferson River, Mont., reservoir sites in basin of 169

K.

- Kachess Lake reservoir, Wash., capacity of. 282
- Kansas, operations in 137-141
- Keechelus Lake reservoir, Wash., capacity of 282
- Kellogg & Worley, contract with 107
- Kervin, J. J., contract with 107
- Kilpatrick Bros. & Collins, contract with 176
- Kittitas project (proposed), Wash., expenditures on 48, 291
  - status of 290
  - *See also* Yakima district projects.
- Klamath project, Oreg.-Cal., allotments for. 43, 45
  - canal on, bids for 256-260
    - plan of headworks and cross sections of 260
    - views of 258
  - cement for, bids on 261
  - contracts for work on 256
  - East Branch canal for 261
  - expenditures on 48, 264
  - lands included in 264
  - laterals for 261
  - litigation concerning 29
  - map of 256
  - property purchased for 33
  - rights of way on 262-263
  - summary of data relating to 255
  - tunnel on, cross section of 260
  - unit prices for work on 61-84
  - work on 255-264
- Klamath Canal Company, litigation with 29
- Klamath Falls, Oregon, view of 256
- Klamath Lake. *See* Upper Klamath Lake.
- Klamath Water Users' Association, organization of 263
- Knowlton & Bollen, contract with 107

L.

- La Plata Valley project (proposed), New Mexico, expenditures on 48, 219
  - status of 219
- Labor conditions, discussion of 36-37
- Laguna dam, Yuma project, gates at, bids on 101
  - sluice gates and canal regulator for, plans for 104
  - views of 102
  - work on 101
- Lake. *See* next word of name.
- Lake basin project (proposed), Mont., expenditures on 48, 164
  - investigations on 159-164

Page.
Lakes in California and Oregon, act authorizing change of level of 20
Land, purchases of, decisions regarding..... 25-26
  restoration of, decision regarding....... 24
  withdrawal of, decision regarding...... 24
Las Vegas project (proposed), N. Mex., expenditures on.................. 48,218
  status of.............................. 218
Leasburg diversion dam, N. Mex., description of....................... 222-223
  expenditures on....................... 48,224
  plans for............................. 222
  summary of data relating to........... 220
  view of site of....................... 224
Leases, decision regarding.................. 27
Leavitt, H. G., litigation with........ 31,180-181
Liabilities, discussion of..................... 49-50
Lifting devices unit prices for..... 75,125,126,148
Lifting devices, setting, bids on............ 147
Lignite, cost of.............................. 226
  fuel value of........................... 225-226
Litigation, discussion of..................... 29-32
Little Colorado project (proposed), Ariz., expenditures on................ 17,93
  status of.............................. 93
Little Missouri project (proposed), N. Dak., expenditures on............... 48,233
  status of.............................. 233
Lovell, W. D., contracts with............ 143,145
Lower Yellowstone project, N. Dak.-Mont., allotments for............... 43,44,45
  canals on, work on..................... 235-239
  contracts for, work on.................. 235
  diversion dam on, bids on............ 239-240
  expenditures on....................... 48,243
  lands included in...................... 242
  property purchased for.................. 34
  sluice gates for, bids on................ 242
  steel for, bids on....................... 241
  summary of data relating to............ 234
  unit prices for work on................. 62-84
  work on.............................. 234-243
Lujane, Colo., view of....................... 108
Lumber, unit prices for..................... 75, 124, 127, 147, 202, 239, 240, 248, 249

M.

McAllister Meadows reservoir, Wash., capacity of............................. 282
McPhee & McGinnity Company, contract with.............................. 110
Madison River, Mont., power plants on .. 168-160
Madison River project (proposed), Mont., expenditures on................ 48,172
  work on.............................. 167-172
Malheur project (proposed), Oreg., allotment for..................... 43,44,45
  expenditures on....................... 48,254
  status of............................ 253-254
Malley, Edward, contract with............. 183
Mason, Davis & Co., contract with......... 256
Masonry, unit prices for.................... 76
Mexico, treaty with, for distribution of waters of Rio Grande........ 221-222
Milk River project, Mont., allotments for. 43,44,45
Milk River project, Mont., expenditures on. 48,154
  lands included in...................... 154
  summary of data relating to.......... 151
  work on.............................. 151-155
  See also St. Mary canal, St. Mary basin.
Milk River Valley, water rights in, adjudication of 153-154
Miller & Peasley, contract with........... 101,102
Minidoka dam, Minidoka project, views of.............................. 116,118
Minidoka project, Idaho, allotments for.... 43,44
  canals on.............................. 118
  contracts for work on.................. 117
  dam and spillway on.................. 117-118
  distribution system for............... 118-119
  expenditures on....................... 48,121
  lands included in 120
  property purchased for................. 34
  reservoir for........................... 119
  right of way obtained for............... 120
  summary of data relating to 116
  town sites on........................... 119
  unit prices for work on................. 62-84
  views on.............................. 116,118
  See also Minidoka dam.
Missouri River, gage heights of, diagram showing......................... 228
  fluctuations of....................... 227-228
  silt in................................. 228
Monarch & Porter, contract with........ 117,118
Montana, operations in........... 142-174,234-243
Munn, James, contract with 238

N.

Navajo reservoir site, Okla., surveys of.. 244-246
Nebraska, operations in.................. 175-182
Nelson, J. A., contract with............. 235,238
Nesson project, N. Dak., allotment for .. 43,44,45
  expenditures on....................... 48,232
  progress on.......................... 231-232
  See also Williston district projects.
Nevada, operations in...................... 183-208
New Mexico, operations in............... 209-224
Newman & Hoy, contract with........... 237,240
Nohle & Mann, contract with............. 235,238
North Dakota, operations in 225-243
North Platte project, Nebr.-Wyo., allotments for 43,44,45
  contracts for work on.................. 176
  distribution system for, bids on........ 179
  diversion dam for, description of....... 179
    plan of............................... 180
  expenditures on....................... 48,181
  lands included in...................... 180
  litigation in connection with........ 31,180-181
  property purchased for................. 34
  right of way for....................... 180
  summary of data relating to.. 175
  unit prices for work on................. 61-84
  views on........................ 176,178,180
  work on.............................. 175-181
  See also Pathfinder dam; Interstate canal.
North Platte River, Nebr., diversion dam in, plans for...................... 180

Page.

O.

O'Connor, J. F., contract with 176, 178
Okanogan project, Wash., allotment for .. 43.45
  canals for, bids on 277-278
  cement for, bids on 278
  expenditures on 48, 278
  gates for, bids on 278
  lands included in 278
  map of 276
  reservoirs for, bids on 276-277
  rights of way on 278
  summary of data relating to 275
  work on 275-279
  See also Conconully reservoir; Salmon Creek reservoir.
Okanogan Water Users' Association, organization of 278
Oklahoma, expenditures in 48, 246
  operations in 244-246
Oregon, lakes in, act authorizing change of level in 20
  operations in 247-264
Orman & Crook, contracts with 107, 110, 117, 118, 176, 266, 267
Overhaul, unit prices for 76-77
Owens Valley project (proposed), Cal., expenditures on 17, 98-99
  status of 98-99

P.

Pacific Coast Construction Company, contract with 183
Page & Brinton, contracts with 123, 126, 128
Palouse project (proposed), Wash., expenditures on 48, 292
  status of 292
Pathfinder dam, North Platte project, views at 176
  work on 176-178
Pavement, unit prices for 77
Paving, bids on 144, 146, 147, 202, 257, 258, 259, 260
Payette-Boise project, Idaho, allotments for 43, 44, 45
  canal for, work on and bids for 126-129
  cement for, contracts for 131
  contracts for work on 123
  dam for, bids for 124
    plans of 124
  embankments for, bids received for and work on 129-130
  expenditures on 48, 135-136
  gates for dam on, bids on 125-126
  litigation concerning 30, 134-135
  lands included in 131-133
  map of 122
  property purchased for 34
  right of way for 133-134
  summary of data relating to 121-122
  unit prices for 63-84
  water rights for 135
  See also Deer Flat reservoir.
Penasco Rock, N. Mex., view of 224
Piles, unit prices for 77-78, 239, 240
Piney Creek, Wyo., water rights on 303

Page.

Pinto pressure pipe, Salt River project, views of 86
Pipe drain, bids on 202, 249, 277
Pipe, terra cotta, unit prices for 82, 236, 237, 238, 239
Pipe, vitrified, bids on 147
Pipers Brothers Company, contract with .. 143, 146, 148
Placing gates, bids on 299
Placing steel, bids on 239, 240
Portland Cement Company, contract with .. 131
Power legislation on 18
Power plants, prices for 64, 139
Prendergast & Clarkson, contract with 297
Pressure pipe, forms for, views of 86
Priest Rapids project (proposed), Wash., expenditures on 48, 293
  status of 292
Property, purchases of, decisions regarding. 25-36
  purchases of, list of 32-36
  sales of, legislation on 20
Public lands, use of material from, legislation on 19-20
  receipts from sale of 40-41
Puddling, unit prices for 78-79, 147, 202, 236, 237, 238, 257, 258, 259, 260, 277
Pumping stations on Buford-Trenton project, N. Dak., plans for 239
Purchases of land and property, decisions regarding 25-26
Pyramid Branch canal, Truckee-Carson project, headworks of 193-194
Pyramid Lake Indian Reservation, act for disposition of lands in 21

R.

Railroads, agreements with 37-39
Receipts for reclamation fund, discussion of. 39-43
Reciprocating steam engine plant, bids on .. 139
Reclamation act, text of 15-17
Reclamation fund, amount of 41-43
Red River, Okla., discharge of 245
  surveys on 244-246
Red Rock River, Mont., reservoir site on 169
Reenforced concrete. *See* Concrete.
Relinquishment, decision regarding 27
Residence, decision regarding 27
Restoration of land, decision regarding 24
Rights, purchases of 32-36
Rio Grande project, N. Mex.-Tex., allotment for 43-45
  diversion dam for 222-223
  expenditures on 48, 224
  views on 222, 224
  work on 220-224
  See also Leasburg dam.
Riprap, unit prices for 79-80, 124, 127, 128, 144, 145, 146, 147, 238, 239, 240, 248, 249, 277, 299
River Portal, Colo., view of 108
Roads, cost of 80
Robinson, S. R. H., contract with 266
Robinson & Maney, contract with 176
Rock fill, unit prices for 80, 239, 240, 248, 249
Rolling embankments, bids on 299

Page.

- Roosevelt, Ariz., view of 86
- Roosevelt dam, work on 86–87
  - work on, plate showing 86
- Roswell National Bank, litigation with 31
- Rubble masonry, bids on 299
- Ruby River, Mont., reservoir site on 169

S.

- Sacramento Valley, description of 94–95
  - expenditures on work in 98
  - flood flow in, relation of storage reservoirs to 97–98
  - investigations in 94–99
  - reservoirs in, capacity of 95–96
  - surveys in 95–96
- St. Mary basin, Mont., map of 152
  - work in 152
- St. Mary canal, Mont., cross sections of 152
- Sale of public land, receipts from 40–41
- Salmon Lake reservoir, Okanogan project, map of 276
- Salmon River, Oreg., flow of 275
- Salt River project, Ariz., allotments for 43, 44
  - cement mill at 88–89
  - contracts for work on 86
  - diversion dam for power canal on, plan of 88
    - work on 87
  - expenditures on 17, 91–92
  - lands included in 90–91
  - litigation concerning 29
  - outlet tunnel at 87
  - power canal on, views of 86
    - work on 87
  - power plant at 88
  - property purchased for 32
  - sand-crushing plant at 47
  - summary of data relating to 85
  - telephone line at 89
  - unit prices for 61–84
  - *See also* Roosevelt dam; Granite Reef dam; Arizona canal.
- San Carlos project (proposed), Ariz., expenditures on 17, 92
  - status of 92
- San Francisco Construction Company, contract with 183
- San Joaquin project (proposed), Cal., expenditures on 17, 99
  - status of 99
- San Pedro project (proposed), Ariz., expenditures on 17, 92
  - status of 29
- Sanders, Mont., surveys near 173
- Selections and entries, decisions regarding 24–25
- Services, method of securing 53–57
- Setting gates and guides, bids on 147
- Setting lifting devices, bids on 147
- Sheet piling, unit prices for 78, 239, 240
- Shoshone dam, Shoshone project, work on 297
- Shoshone project, Wyo., allotment for 43, 45
  - canal on, bids for 298–299
  - cement for 299–300
  - contracts for work on 297
  - dams for 297–298
  - expenditures on 48, 301
- Shoshone project, Wyo., lands included in 300
  - lumber for 300
  - property purchased for 36
  - summary of data relating to 296
  - tunnel on 297–298
  - unit prices for work on 61–84
  - views on 296, 298
  - work on 296–301
  - *See also* Shoshone dam; Corbett tunnel; Corbett dam; Garland canal.
- Shoshone River, Wyo., temporary dam in, views of 296
- Sixteenmile Creek, Mont., reservoir site on 169
- Slinkard Construction Company, contract with 215
- Sluice gates, Granite Reef dam, Salt River project, plans of 90
  - Laguna dam, Yuma project, plans for 104
- South Dakota, operations in 265–270
- South Platte Valley, investigations in 182
- Spanish Fork, Utah, discharge of 273
- Spear, Charles, contract with 297
- Spring Canyon draw, Nebr., flume at, view of 178
- Stabern, Charles, contract with 235, 238
- Stanley, J. F., contract with 176
- Steam turbine plant, bids on 139
- Steel, unit prices for 80–81, 124, 127, 129, 130, 148, 202, 239, 241, 250, 299
- Steel, placing bids on 239
- Steel rods, bids on 202
- Stone, E. B. and A. L., contract with 183
- Strawberry River, Utah, discharge of 273
- Strawberry Valley project, Utah, allotment for 43, 45
  - canal and tunnel on, profile and cross sections of 272
  - expenditures on 48, 273
  - map of 272
  - roads on 271
  - telephone system for, bids on 272
  - tunnel for 272
  - work on 271–274
- Stripping, bids on 277
- Sun River project, Montana, allotment for 44, 45
  - expenditures on 48, 159
  - water rights for, adjudication of 158–159
  - work on 155–159
- Sunnyside project, Wash., allotment for 43, 44, 45
  - expenditures on 48, 288
  - lands included in 288
  - summary of data relating to 286
  - work on 286–288
  - *See also* Yakima district projects.
- Sunnyside Water Users' Association, organization of 287
- Swain, C. W., contract with 183

T.

- Taylor-Moore Construction Company, contracts with 107, 215
- Telephone system, unit prices for 81–82, 148–149
- Terra-cotta pipe, unit prices for 82
- Texas, extension of reclamation act to 17
  - operations in 220–224
- Thompson, W. H., contract with 123, 126, 128

Page.

- Thorpe, J. R., contract with ... 89
  - litigation with ... 29
- Tieton project, Wash., allotment for ... 43, 44, 45
  - expenditures on ... 48, 286
  - summary of data relating to ... 284-285
  - work on ... 284-286
  - *See also* Yakima district projects.
- Toston, Mont., proposed irrigation project near ... 172
- Town sites, legislation on ... 17-18, 19
  - on Belle Fourche project ... 270
  - on Minidoka project, opening of ... 119
- Transportation office, work of ... 37
- Truckee canal, Truckee-Carson project, description of ... 189-196
- Truckee-Carson project, Nev., allotments for ... 43, 44, 45
  - contracts for work on ... 183
  - dam and diversion works on ... 186-188
  - distributing canals on ... 196-200
  - duty of water on ... 200-201
  - expenditures on ... 48, 207
  - head-gates for ... 188
  - lands included in ... 206
  - lateral ditches on, bids on ... 202
  - litigation concerning ... 31
  - maintenance and operation of ... 202-206
  - map of ... 186
  - property purchased for ... 35
  - seepage on ... 205
  - summary of data relating to ... 183
  - telephone construction on ... 201
  - tunnels on ... 190-191
  - unit prices for work on ... 61-84
  - wasteways on ... 190-193
  - work on ... 183-207
- Truckee River basin, Nevada, description of ... 184
- Tunnel, unit prices for ... 82-83, 144, 257, 258

U.

- Umatilla project, Oreg., allotment for ... 43, 45
  - cement for, bids on ... 250
  - dam for, bids on ... 249-250
    - plan of ... 248
  - expenditures on ... 48, 253
  - feed canal for, bids on ... 248-249
    - cross sections of ... 248
  - lands included in ... 250-251
  - litigation concerning ... 31-32
  - map of ... 248
  - right of way for ... 251
  - steel for, bids on ... 250
  - summary of data relating to ... 247
  - unit prices for work on ... 63-84
  - work on ... 247-253
  - *See also* Cold Springs dam.
- Umatilla River, Oreg., diversion dam in plan of ... 248
- Uncompahgre Valley project, Colo., allotment for ... 43, 44
  - cement for, bids on ... 110-111
  - contracts for work on ... 107
  - distribution system for ... 112
  - east canal on, plans for ... 111
  - expenditures on ... 48, 113-114
- Uncompahgre Valley project, Colo., lands included in ... 112-113
  - litigation concerning ... 30
  - map of ... 106
  - south canal on, work on ... 110-111
    - views of ... 110
  - summary of data relating to ... 106
  - unit prices for work on ... 61-84
  - views on ... 108, 110
  - west canal on, plans for ... 111-112
  - *See also* Gunnison tunnel.
- Union Gap Irrigation Company, agreement with ... 282
- Unit prices, table showing ... 61-84
- Upper Klamath Lake, Oreg., view of ... 256
- Urton Lake project (proposed), N. Mex., expenditures on ... 48, 218
  - status of ... 218
- Utah, operations in ... 271-274
- Utah Construction Company, contract with 183
- Utah Fireproofing Company, contract with ... 123, 124
- Utah Lake project (proposed), Utah, expenditures on ... 48, 274
  - status of ... 274

V.

- Vandall, M. F., litigation with ... 31
- Vulcan Iron Works, contract with ... 117, 118

W.

- Waco, Mont., surveys near ... 173
- Walker River project (proposed), Nev., expenditures on ... 48, 207-208
  - status of ... 207
- Wapato project, Wash., allotment for ... 44, 45
  - expenditures on ... 48, 289
  - work on ... 288-289
  - *See also* Yakima district projects.
- Warren, C. A., & Co., contracts with ... 183
- Washington, operations in ... 275-295
  - State waters in, use of ... 293-295
- Water right, decisions regarding ... 26
- Water users' associations, list of ... 28-29
- Wells, artesian, unit prices for ... 83
- Wells, authority to drill ... 26-27
- Western States Portland Cement Company, contract with ... 110
- White, J. G., & Co., contracts with ... 101
- White River project (proposed), Colo., expenditures on ... 48, 115
  - status of ... 115
- Widell-Finley Company, contracts with ... 235, 238, 266
- Williams, C. W., injunction against ... 29
- Williston, N. Dak., gage height of Missouri at, diagram showing ... 228
  - rainfall at ... 228
- Williston district projects, N. Dak., discussion of ... 225-233
  - power stations for, location of ... 226
  - pumping [illegible]tions for ... 227
  - settling [illegible] for ... 228-229
  - *See also* Buford-Trenton project, Williston project, Nesson project.
- Williston project, N. Dak., allotment for ... 43, 45
  - description of ... 230

Page.

Williston project, N. Dak., expenditures on........................... 48, 231
  map of.................................. 230
  See also Williston district projects.
Wire fabric, unit prices for............... 83, 299
Withdrawal of land, decision regarding.... 24
Wood, Bancroft & Doty, contract with... 215
Wyoming, operations in.......... 175-182, 296-304

Y.

Yakima district projects, Washington hydrographic work on............. 284
  litigation concerning.................... 32
  location and extent...................... 279
  property purchased for.................. 36
  roads on, construction of............... 284
  storage reservoirs for................. 282-283
  water rights for, adjustment of...... 280-282
  work on.............................. 279-291
  See also Tieton project; Sunnyside project, Wapato project, Kittitas project, Benton project.

Page.

Yakima Indian Reservation, act for disposition of lands in................. 22-23
Yakima River, Wash., water rights on, adjustment of................... 280-282
Yellowstone River, Mont., dams across, act authorizing..................... 2
Yuma project, Ariz.-Cal., allotments for ... 43, 44
  conduit for main canal of.............. 102
  contract for work on................... 101
  crossing for Gila River, plans for...... 102
  dikes on................................ 102
  distribution system for................. 102
  expenditures on..................... 48, 102
  lands included in................... 102-103
  litigation concerning................. 29-30
  map of................................ 102
  property purchased for................ 33
  summary of data relating to........... 100
  unit prices for....................... 63-84
  views on.............................. 102
  work on............................. 100-105
  See also Laguna dam.

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